sportation
Library

JAN 16 1947

January
1947

Railway Mechanical Engineer

UNIT TRUCK

A STATEMENT OF POLICY

Transportation Library
TF
1
.R16
V.121

The economic problems faced by the American Railroads today make it a matter of urgent necessity that every proven device which makes for greater operating efficiency, safety and economy, can and must be made available to all for the common good.

Conventional hangered brake beams have always presented a vexatious operating problem to the railroads. Because this is a major item of interchange, we deem it a matter of basic policy that the UNIT braking system shall be available to the industry through every manufacturer of freight car trucks, side frames, and/or brake beams, subject only to such control on our part as may be required to assure to the railroads, UNIT'S exceptionally high standard of design and workmanship.

That is why your next inquiry for UNIT BRAKE BEAMS, or for truck side frames equipped with UNIT brake beam guides (UNIT TRUCKS), may be sent directly to the supplier with whom you are now regularly doing business, or to ourselves, as you prefer.

UNIT TRUCK CORPORATION - - - NEW YORK

Published monthly by Simmons-Boardman Publishing Corporation, 1309 Noble Street, Philadelphia, Pa. Entered as second-class matter, April 3, 1933, at the Post Office at Philadelphia, Pa, under the act of March 3, 1879. Subscription price, $3.00 for one year, U. S. and Canada. Single copies, 50 cents. Vol. 121, No. 1

RAILWAY MECHANICAL ENGINEER

With which is incorporated the RAILWAY ELECTRICAL ENGINEER

(Names Registered, U. S. Patent Office)

Founded in 1832 as the American Rail-Road Journal

JANUARY, 1947

Volume 121 *No. 1*

Roy V. Wright
Editor, New York

C. B. Peck
Managing Editor, New York

A. G. Oehler
Electrical Editor, New York

E. L. Woodward
Western Editor, Chicago

H. C. Wilcox
Associate Editor, New York

C. L. Combes
Associate Editor, New York

G. J. Weihofen
Associate Editor, New York

Robert E. Thayer
Vice-Pres. and Business Manager, New York

Published on the second day of each month by

Simmons-Boardman Publishing Corporation

1309 Noble street, Philadelphia, Pa. Editorial and Executive Offices: 30 Church street, New York 7, and 105 West Adams street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D. C.; 1038 Henry bldg., Seattle 1, Wash.; 300 Montgomery street, Room 805-806, San Francisco 4, Calif.; 560 W. Sixth street, Los Angeles 14, Calif.; 2909 Maple Avenue, Dallas 4, Tex.

SAMUEL O. DUNN, *Chairman of Board, Chicago;* JAMES G. LYNE, *Vice-President — Assistant to Chairman, New York;* HENRY LEE, *President, New York;* ROY V. WRIGHT, *Vice-Pres. and Sec., New York;* FREDERICK H. THOMPSON, *Vice-Pres., Cleveland;* FREDERICK C. KOCH, *Vice-Pres., New York;* ROBERT E. THAYER, *Vice-Pres., New York;* S. WAYNE HICKEY, *Vice-Pres., Chicago;* J. G. LYNE, *Vice-Pres., New York;* H. E. MCCANDLESS, *Vice-Pres., New York;* C. MILES BURPEE, *Vice-Pres., New York;* JOHN T. DEMOTT, *Treas. and Asst. Sec., New York.*

The Railway Mechanical Engineer is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service. PRINTED IN U. S. A.

Subscriptions, payable in advance and postage free, United States, U. S. possessions and Canada: 1 year, $3; 2 years, $5. Other countries in Western Hemisphere: 1 year, $5; 2 years, $8. All other countries: 1 year, $7; 2 years, $12. Single copies, 50 cents. Address H. E. McCandless, circulation manager, 30 Church street, New York 7.

Locomotive:

Relation of Design to Maintenance of Diesel Power 1
Alloy Steels for Welded Locomotive Boilers 6
Austria Revives Fireless Steam Locomotives 14

Car:

The Problem of Passenger-Car Weight 4

General:

West Burlington Diesel Shop 9

Editorials:

Steam Power Shows New Signs of Life 16
The Case for Head-End Power 16
An Added Incentive for Better Counterbalancing 17
Maintenance Standards 17
1946 A Big Year In Shop Programs 18
New Books 18

With the Car Foremen and Inspectors:

Hot Boxes in Freight Service 19
Checking Clearances on Canadian Pacific Cars 21
Testing Type AB Brakes 22

In the Back Shop and Enginehouse:

Locomotive Failures 24
Slotting Eccentric Cranks 26
Locomotive Boiler Questions and Answers 26
Pneumatic Clamps for Stack Cutting 27

Electrical Section:

Maintaining Waukesha Equipment 29
Electronic Air Conditioning Control 32
Diesel Locomotive Design for Lower Electrical Maintenance 35

New Devices:

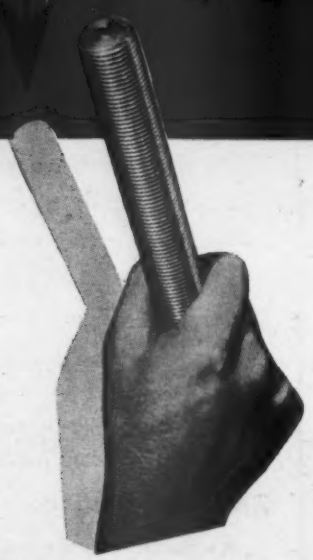
Floor Cleaning Machine 38
Radius Grinding Attachment 38
Flareless Fitting 38
Self-Locking Power Reverse Gear 39
Sand Trap for Steam Locomotives 40
Drop End Balancer 40
Valve With 30-Deg. Body 41
Diesel-Drive Control 41

News 42

Index to Advertisers ..... (Adv. Sec.) 112

Languages and customers may differ . . . but railroad men in South America see eye-to-eye with leading North American railroaders when it comes to safeguarding availability, and avoiding repairs and maintenance. A number of new locomotives recently built by Baldwin Locomotive Works for Colombia were all equipped with staybolts made from Byers Staybolt Iron.

Few pieces of equipment on the locomotive face a greater variety of severe service conditions than staybolts. They are exposed to firebox temperatures of up to 2700°, steam temperatures of from 350°to 400°, abrasion from hot coals and cinders. Each one must carry a load of several thousand pounds, and endure extra stresses due to boiler and firebox movement. Severe vibration is always encountered, that causes early fatigue failure in vulnerable materials.



Byers Staybolt Iron has a combination of service qualities that successfully withstands these conditions. In addition it is easily threaded, drilled, and headed, which speeds up fabrication. Almost 100 leading railroads have installed staybolts of Byers Staybolt Iron.

Every step in the production of Byers Staybolt Iron is under careful control. All material is twice piled, and all slabs run the full length of the pile. The reduction in section from original blooms to final blank is over 50,000 to 1. This large reduction helps produce an exceptionally good slag distribution.

You can specify Byers Staybolt Iron when you order from your staybolt manufacturer, or buy blanks for fabrication in your own shop.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Seattle, San Francisco.

FORGING BILLETS. The same unusually high quality and uniformity found in Byers Staybolt Iron are duplicated in Byers Forging Billets. They are produced in round, square or rectangular sections, under ASTM-A-73 and AAR-M-307 Specifications.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

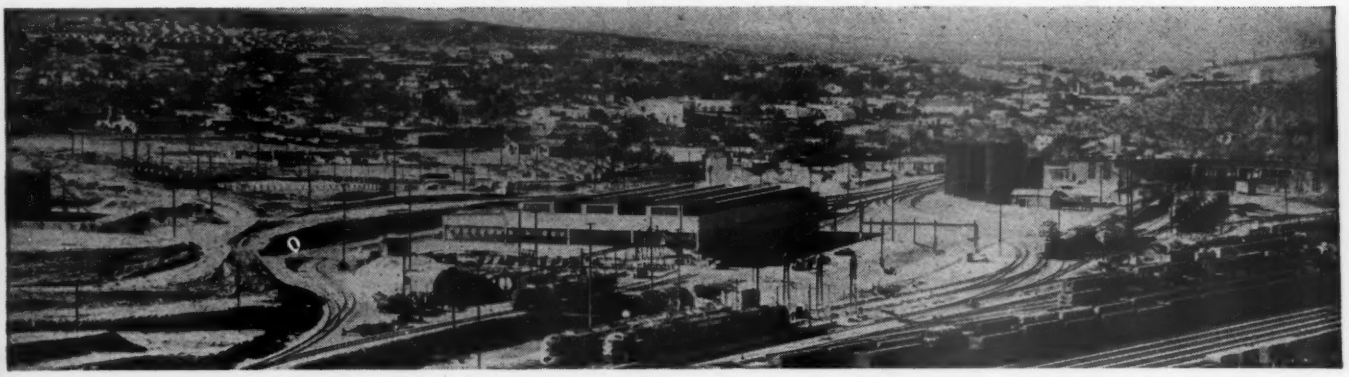
BYERS

GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE ALLOY STEELS · OPEN HEARTH ALLOY STEELS
CARBON STEEL TUBULAR PRODUCTS

RAILWAY
MECHANICAL ENGINEER



Diesel shop and facilities of the Atchison, Topeka & Santa Fe at Barstow, Calif.—Diesel locomotive and service track in center.

Relation of Design to

Maintenance of Diesel Power*

By J. P. Morris†

Repairs, failures and utilization of Diesel locomotives on the Santa Fe listed — Many recommendations made for changes in future design to reduce the cost of maintenance

THE first Diesel-electric locomotive was placed in service on the Santa Fe in 1935 and has been supplemented by additional locomotives until at the present time there is a total of 658,760 Diesel horsepower in service. In addition to those that we have in service, we have on order four 6000-hp. passenger locomotives and four 1000-hp. combination road-and-switching locomotives from the American Locomotive Company, and one 6000-hp. passenger locomotive is being built for us by the Fairbanks-Morse Company, which will give us a total of 692,760 Diesel engine horsepower when those locomotives are placed in service. These locomotives were manufactured by seven different locomotive builders and consist of 25 different designs.

Table I—Diesel Locomotive Costs

Percentage Relationship of Operating Cost Items

Type of locomotive	Repairs	Lubricants	Fuel	Total
Switch	6.74	0.46	2.59	9.79
Passenger	33.69	4.72	23.95	62.36
Freight	18.91	1.73	7.21	27.85
Total	59.34	6.91	33.75	100.00

Repairs

	Diesel engines	Electrical equip.	Other repairs	Total
Labor	28.85	12.92	10.49	52.26
Material	25.79	11.04	10.91	47.74
Total	54.64	23.96	21.40	100.00

AVAILABILITY AND UTILIZATION

Switch Locomotives

	1941	1942	1943	1944	1945	Average
Availability	....	....	92.2	92.4	92.2	92.3
Utilization	....	....	96.8	95.7	89.9	93.8

Freight Locomotives

	1941	1942	1943	1944	1945	Average
Availability	89.95	89.08	87.45	84.93	85.63	87.4
Utilization	66.23	73.39	75.95	76.85	71.79	72.8

Diesel Passenger Unit Mileage Per Month

1941	1942	1943	1944	1945	Average
18,270	19,126	18,087	17,635	17,295	18,057

The locomotive repair cost has been the major expense involved and it exceeds the cost of fuel and lubricants combined, inasmuch as 59.34 per cent of the expense as a whole was for repairs, 33.75 per cent for fuel, and 6.91 per cent for lubricants. Repairs for the Diesel engines required 54.64 per cent of the total money spent for repairs; the electrical equipment required 23.96 per cent; and other parts of the locomotive required 21.40 per cent. Material costs amounted to 47.74 per cent of the total repair costs, and labor amounted to 52.26 per cent. Table I indicates the distribution of this expense. The switch locomotives had an average availability of 92.3 per cent and were utilized 93.8 per cent of the time they were available. The freight locomotives had an average availability of 87.4 per cent and were utilized 72.8 per cent of the time they were available. The passenger locomotives averaged 19,057 miles per unit per month. This information is grouped according to years in Table I.

The majority of the Diesel engnie repair costs were caused by repairs to pistons, connecting rods, cylinder

*A paper presented before a session of the Railroad Division, American Society of Mechanical Engineers, at New York on December 4.

†General assistant (mechanical), Atchison, Topeka & Santa Fe, Chicago.

liners, cylinder heads, crankcases, crankshafts, and crankshaft bearings. The majority of the electrical equipment repair cost was caused by repairs to the main generators and traction motors.

Routine preventive maintenance scheduled on a progressive basis has been utilized to keep the equipment in good operating condition and to maintain maximum availability, which is necessary in order to obtain minimum maintenance costs. The frequency for making the various inspections has been predicated on the requirements of the service and the performance of the locomotives. The cost involved for doing this routine work is only a portion of the total expense, inasmuch as failures of expensive pieces of equipment such as crankshafts, crankcases, traction motors, and main generators, necessitating removal for repairs, have caused maintenance costs to be greatly increased above what they should be. Since 1941, 18.9 per cent of the Diesel engines now in service have been removed for repairs due to damaged crankcases or crankshafts. Since 1942, 14.4 per cent of the main generators now in service have been removed for repairs due to defects. In 1944, 22.1 per cent of the traction motors in service were defective and had to be changed for repairs, in 1945, 30 per cent, and, during 1946 up to August 1st, 11 per cent. Table II lists the information covering the defective Diesel engines, main generators and traction motors for each of the years mentioned.

Interruptions to the service caused by failures enroute of the locomotive equipment have been quite evenly divided between the Diesel engine and the electrical equipment. Since January, 1938, 45 per cent of the failures have been chargeable to the Diesel engines; 47 per cent have been chargeable to the electrical equipment; and 8 per cent were chargeable to other equipment on the locomotives. Table III lists the percentage of these failures for each of the years, 1938 to 1945, inclusive.

Table II—Percentage Record of Defective Diesel Engines, Main Generators and Traction Motors Removed for Repairs

Year	Diesel engines	Main generators	Traction motors
1942	4.8	..	..
1943	8.1	0.37	..
1944	12.1	5.9	22.1
1945	14.9	11.2	30.0
1946 up to August 1	18.9	14.4	11.0

Figures given for Diesel engines and main generators are based on total of removals up to the end of the year shown. Figures given for traction motors are based on removals during each year.

An analysis of the operation of this fleet of locomotives indicates that equal recognition should be given to the Diesel engine and the electrical equipment for improving the operation and reducing maintenance costs.

Supervision and Instruction of Personnel

Many expensive repairs and interruptions to the service are caused by man failures and in order to reduce this to a minimum it is necessary to have adequate and well-trained supervision to instruct the persons who repair and operate the locomotives. The Diesel locomotives are intricate machines consisting of thousands of different parts and it requires a considerable period of time to develop personnel to the degree where they are competent to supervise and instruct, repair or operate the locomotives in the proper manner. Past experience has indicated that supervision having only steam locomotive experience is not adequately qualified for economical use on Diesel locomotives without considerable special training. Details must be closely followed in order to detect impending trouble and to make corrections before expensive repairs result. Adequate and well qualified supervision and instruction are a very important factor in reducing maintenance costs and are becoming more important every day because so many different types of locomotives are being placed in service.

Table III—Diesel Locomotive Failures

Year	Per cent chargeable to: Diesel engines	Electrical equipment	Other equipment
1938	52	38	10
1939	41	28	31
1940	21.5	57	21.5
1941	30	60	10
1942	38	48	14
1943	33	59	8
1944	53	44	3
1945	45	50	5
1938 to 1945 incl.	45	47	8

Repair Facilities

It is essential that separate well designed facilities be provided for Diesel locomotive repairs in order that the work may be done efficiently and economically, and that the highest availability be attained. When planning new facilities for Diesel repairs an endeavor should be made to concentrate as much work as possible at the same facility in order to utilize personnel and material more efficiently. An endeavor should also be made to utilize one of the greatest advantages the Diesel locomotive possesses—the ability to operate long distances between inspections—when determining the number of facilities required and where they should be located. As the Diesel locomotive replaces the steam locomotive there will be steam locomotive repair facilities which can be remodeled to handle Diesel repairs, and there will also be steam repair facilities which can be abandoned if all the advantages of the Diesel locomotive are utilized. Proper utilization and design of maintenance facilities are a very important factor in reducing maintenance expense.

Maintenance Schedules

The common practice in the past has been to handle the work progressively in order to maintain good availability, the amount of work handled during any one detention being dependent on the time available and the size of the maintenance force. This method has been quite successful, but, as the size of the Diesel fleet increases at individual maintenance terminals, it has been found advantageous to reduce the frequency of detentions for inspections and to increase the number of inspection items handled at each detention for repairs. In handling in this manner there is a considerable saving in man hours. However, it is necessary that the quality of the work performed be the best. As refinements are made in the locomotives and better parts become obtainable the maintenance schedules should be revised accordingly to take full advantage of the economics involved.

Water, Fuel, and Lubricants

With reference to the quality of fuel, lubricants, and water available, past experience has shown that certain qualities are necessary in each and that when they are lacking it results in expensive maintenance of the Diesel engines. The demand for Diesel fuel is steadily increasing, resulting in a shortage of fuel possessing the qualities needed for good performance. Unless these can be provided it will be necessary to design new engines and redesign existing ones so that both will be capable of using the type of fuel available without excessive maintenance.

At the present time there are numerous types and kinds of lubricants in use on the Diesel locomotives which possess many good qualities and it does not appear that there will be any shortage of them in the future; however, the perplexing problem is that it is not recommended nor deemed advisable to mix them in the same engine as this results in considerable confusion and expense

where more than one type of lubricant is used, especially where permanent lubricating oil facilities are installed with numerous outlets.

This is a serious problem confronting the railroads and one which requires the combined attention of both the lubrication manufacturers and the engine manufacturers to overcome. In the past it has been more or less common practice to change lubricating oil in Diesel engines at certain frequent intervals, which has resulted in considerable expense. Experience to date has indicated that this is unnecessary on some types of lubricating oils when proper filtration is provided and filter elements are changed at necessary intervals. Contaminated oil is detected by close supervision and careful inspection, at which time it is changed. This latter policy has done considerable towards reducing maintenance costs.

The average water available for use in cooling systems of Diesel engines and steam generators can not be used without causing difficulty and expensive maintenance. Performance has indicated that treated water containing a minimum of total solids must be available. The treatment of water on individual locomotives is very difficult to control and can best be handled by providing wayside facilities for treating and storing the water. The use of properly treated water free of solids is an important factor in reducing maintenance costs.

Repair Materials

The cost of materials for repairs, as previously stated, amounted to 47.74 per cent of the total cost of repairs and I am of the opinion that those of you engaged in the maintenance of Diesel motive power will agree that the material costs are too high if we are to maintain this type of power at a reasonable maintenance cost. Unless a substantial decrease can be affected by the builders, consideration will undoubtedly be given by railroads who are equipped with fine machine tools to engage in the manufacture and repair of equipment that can be handled in their present facilities.

I wish to call to the attention of the builders the necessity when designing new locomotives that consideration be given to the standardization of parts insofar as possible, so that the railroads will not be required to make such heavy investment in material stocks as a result of the parts not being interchangeable.

Effect of Load Factor

Power plants which are operated at high load factors require more maintenance than those which are not as heavily worked, and they are not as reliable. This has been particularly true of Diesel engines, main generators and traction motors. Locomotive performance, both from operating and maintenance standpoints, is considerably improved when using locomotives with sufficient capacity to allow operation at reduced throttle a portion of the time. Locomotives having this increased capacity are also sufficiently flexible to handle variations in scehdules and train consists when they occur.

Design of New Power

Regarding the improved design of the Diesel Electric locomotive to reduce maintenance costs, there are many changes and improvements which should be considered on existing locomotives and new locomotives to be built, such as the following:

Reduction of number of power plants comprising the locomotive to reduce the number of parts involved.

Interchangeability of parts by standardizing on necessary dimensions.

Ample reserve capacity built into the power plant to allow for more reliability.

Application of adequate filtering capacity in the lubricating-oil system to maintain the oil in good condition without frequent filter changes.

The use of crankshaft bearings which will be more dependable and give longer life.

Filtration of all air entering the engineroom and power plant equipment by application of filters to the car body.

The use of stainless steel on the locomotive car body to eliminate repainting expense.

The use of oil lubrication in the traction-motor armature bearing to improve lubrication.

The use of felt wick oilers instead of wool packing in traction-motor suspension bearings to obtain better lubrication and to simplify the packing procedure.

Additional refinement of traction motors and generators in order to obtain greater dependability and longer life between rewinds.

Application of automatic protection on Diesel engines to protect fully the engine from excessive cooling water temperatures and low oil pressure.

The use of totally enclosed relays to prevent dirt interfering with the operation of the controls.

Improvement of brush life and commutator conditions on main generators and traction motors to obtain at least one year's service between renewals.

Improvement of cylinder wear by the use of chromium plating or other means to secure longer cylinder life and to eliminate use of oversized parts caused by reboring.

Development and application of automatic devices to prevent damage to generators and traction motors due to overload.

The use of fully automatic transition to eliminate failures of electrical equipment due to improper manipulation of the controls by the operator.

The use of lubricating oil pumps with ample reserve capacity on Diesel engines.

Construction of cooling systems having ample capacity, and designed in such a manner that the hazard of water leaking into the lubricating oil is reduced to a minimum.

Elimination of moisture and oil from the air compressor entering the air equipment.

Application of barring over devices to Diesel engines designed for one-man operation.

Lubricating oil and water circulating passages built in as an integral part of the engine with suitable inspection and clean-out openings at proper intervals to piping.

The utilization of a simple arrangement for attaching cylinder heads to cylinder blocks using moderate-sized attachments to eliminate fatigue of man power in applying and removing heads, and to reduce the expense of labor in performing this operation to a minimum.

Provide for accessibility at the flywheel end of the main generator for cleaning and maintenance. There are other important factors which should receive consideration when new designs are contemplated, and which are important from an economic standpoint even though they do not reduce maintenance cost.

Adequate fuel and water capacity should be built into the locomotive to reduce wayside servicing facilities to a minimum on long distance runs.

The weight should be properly distributed and the wheel diameters selected for reducing shear stress below 67,500 lb. and for preventing shatter cracking of rails at high speeds.

Increased-capacity dynamic brakes should be applied to minimize the use of airbrakes and to reduce wheel removals on account of overheating from brake shoes.

In closing, it is fitting to say that the Diesel electric locomotive is the most valuable and expensive tool ever placed in the hands of railroad men and its use and well being must be carefully supervised and controlled.

The Problem of

Passenger-Car Weight*

By Paul W. Kiefer†

Weight reduction not the only objective of the passenger-car designer—Smooth and shock-free operation, service reliability and control of initial costs must not be overlooked

DURING the Railroad Division sessions at the annual meeting of the American Society of Mechanical Engineers held at New York in November, 1946, the subject of weight reduction in the various items of equipment, appliances, fittings and furnishings embodied in the modern passenger car received considerable attention. Representatives of the railroads, as well as those of the car builders, expressed, in effect, the belief that the point had then been reached where further practical weight reduction in such cars would have to be centered largely in items which, including running gear, account for two-thirds or more of the total dry weight complete.

Then, when the program for this session was formulated, it was decided that this important question should be made the subject of detailed discussion with the hope that definite progress might result through the interchange of ideas and submission by the various manufacturers and suppliers involved of detailed statements covering reductions in weight believed to be practicable now or in the future, supplemented by condensed information as to just how this might be accomplished in each instance—that is, through the use of lighterweight materials, new or refined designs, simplification, or other means. The interested manufacturers also were to be requested to supply the weights of present constructions or equipment furnished by them and the reductions to be expected or which might consistently be anticipated in the not too distant future through further study and applied research.

It is anticipated that through the participation of the considerable number of manufacturers and suppliers here present, all of whom contribute importantly to the complete modern passenger-car unit, definite and constructive progress will be registered or initiated.

To begin with, a good case can be made for the present total weight of the modern passenger car, with specialty equipment, appliances, and furnishings included, and I want to emphasize that we must not run wild on the matter of total weight reduction to the extent of increasing out-of-service time for running and shop repairs, raising maintenance costs, or unduly shortening useful anticipated service life. If this were done, it probably would break us a few years hence after substantial numbers of unduly lightened cars had seen service.

Neither must we permit weight savings alone to detract from, or impair, the relatively smooth and shock-free operation which has been achieved through improvements developed during recent years. If we sacrifice these in any way, we will cause our passenger-train service to become less attractive to the traveling public. Obviously, combined efforts in this direction should be intensively continued. Stated otherwise, experience sometimes dictates that in certain instances, particularly with respect to features affecting the dynamics of train movement, the judicious use of reasonable weight additions is fully justified to obtain the required results.

Another consideration of outstanding importance relates to initial costs. With the extremely high prices now being paid for modern coaches, even when ordered in quantities, and for cars of other kinds needed to fill out modern consists, such as diners, sleepers, lounges, observation and others at proportionately higher figures, I want to underline the fact that the margin of return on investments in such equipment continues to become thinner, even with such cars making 250,000 to 300,000 miles annually in revenue trains, which is equivalent to about what must be done at present costs for economic survival. On this account, a positive joint responsibility is here present. We of the railroads, suppliers and builders must keep constantly before us the problem of the over-all economic situation and realize that initial costs must be kept under control. For the rail transportation industry to continue to live as a self-supporting enterprise, all concerned must contribute something to this end in order successfully to weather the storms ahead.

To size up the present situation in a constructive manner, it is not necessary to go back to the steel coach and other kinds of passenger cars built some 25 to 30 years ago, considerable numbers of which are still in

Table I—Present Status of Passenger-Car Weight Reductions

Line No.:	(1)	(2) Coaches: Late 1920's*—Carbon-steel; riveted body	(3) Coaches: 1945†—High-tensile, low-alloy steel; welded, non-fluted body	(4) Per cent change (Col. 3 compared with Col. 2)
1	Complete car, lb.	130,900	121,000	- 7.5
2	Two four-wheel trucks, complete, ready for service; 36-in. multiple-wear rolled-steel wheels, lb.	34,000	39,500	+ 16.1
3	Body, completely equipped, lb.	96,900	81,500	- 15.9
4	Equipment and specialties, added to the body shell, lb.	40,300	50,600	+ 25.5
5	Body shell, without equipment or specialties, lb. Line 3 - Line 4)	56,600	30,900	- 45.4
6	Body equipment and specialties, percentage of complete body (Line 4 ÷ Line 3)	41.6	62.0	+ 49.0
7	Coupled length, ft.	79.	85.	+ 7.6
8	Passenger seating capacity	84	56	- 33.3

* Not air conditioned.
† Air conditioned.

* This article is based on remarks with which the author opened the Forum on Weight Reduction in Passenger-Car Equipment and Specialties at the session of the Railroad Division at New York on December 5 during the annual meeting of the American Society of Mechanical Engineers.

† Chief engineer motive power and rolling stock, New York Central System.

service. Without air conditioning or other numerous modern features, such cars weigh on the order of 140,000 to 150,000 lb. each, with many sleeping cars of substantially greater weights. Rather let us set up a condensed comparison of the coach of the late 1920's with the representative streamline construction of today. A few basic figures are given in Table I.

From line 7 it is seen that the coach of 1945 (Column 3) is 6 ft. longer than the coach of the 1920's (Column 2). This modern coach also contains tight-lock couplers with swinging supports and a complement of heavy metallic connectors; air-conditioning and modern ventilating apparatus with correspondingly heavier generating equipment; much larger batteries; a number of electric control devices; streamlining, including end closures and folding steps; more extensive lighting; high-speed brakes, roller bearings and otherwise specially equipped trucks, and numerous other items. Notwithstanding these additions and the increased length, this car is about 7½ per cent lighter than the car of some two decades ago. This did not just happen, but is the result of better materials and processes, accumulated experience and careful designing throughout, including the development and installation of the large amount of additional specialty equipment for the comfort, convenience and safety of the occupants, not embodied in the older car. It might be said that the coach in Column 2 has a seating capacity of 84 against only 56 for the modern unit. This is true, but the seats of the latter are of the de luxe revolving, reclining type, and the combined toilet and smoking rooms are much more spacious and better equipped.

Also, special attention is directed to line 5 which shows that the body shell weight of the car of Column 3, without equipment or specialties, has been reduced about 45 per cent as compared with that of Column 2, although the length has been increased 7½ per cent and the inside clear width is on the order of 4 in. greater than that of the older car. This reduction in large part has resulted from the availability and adaptability of improved high-tensile materials for body construction purposes, in combination with careful research, design studies and better methods of fabrication and construction.

Further Action Suggested

Certain items added to the car body are not infrequently provided by the builder, such as tight-lock coupler supports, vestibule trap doors and steps, supply tanks, supporting structures inside and outside of the car, doors, interior partitions, built-in seats and similar furniture, and a large amount of miscellaneous hardware, in which, taken collectively, some worthwhile further weight-saving should be made, independently of the weight of the body shell, without detrimental effect.

Now for the other side of the problem. One of the difficulties faced in the analysis of this total question is the lack of detailed weight information comprehensively broken down for the other parts of the car, including running gear. The trucks complete, ready for service, should serve as a good example. By using an approved and established alloy steel for the important castings, consisting of frames, bolsters, center plates, spring planks, equalizer spring seats, filler blocks and miscellaneous items, it has been demonstrated that about 1,550 lb. per car set can be saved as compared with these parts made in Grade A cast steel and other presently used materials, such as were embodied in the trucks of the modern car, Column 3. While this represents a worthwhile reduction and amounts to about 1.28 per cent of the total car dry weight, it leaves for further consideration, exclusive of wheels and axles, such items as clasp-brake rigging, brake cylinders, shoes and keys, slack adjusters, piping and fittings, equalizers, swing hangers and connections, shock absorbers and supports, roller bearings and boxes, wheel-slip control mechanisms, and a number of other miscellaneous parts, all of which amount in weight to some 14,000 lb., or about 11.5 per cent of the total dry weight.

When considering equipment and specialties other than applied to the trucks, we find from line 6 of the table that these items represent approximately 62 per cent of the weight of the fully equipped and complete body and that this total is made up of a large number of items. These may be classified broadly as coupler equipment, windows and fixtures, inside finish and furnishings, heating installations, water supply, body foundation and pneumatic brake parts, electrical equipment, insulation, and air conditioning and ventilating apparatus.

Now each of the items making up these respective classifications should be studied in detail and one of the essential needs is a careful breakdown of the weights of the respective component parts, including for each detail separation of construction materials necessary for installation.

Much progress has been made but more should be forthcoming. In addition to the procedure here outlined and what the car builders themselves may be able to accomplish in lightening the numerous items which they add to the car body, other possibilities of weight reduction which, in total, might come to a substantial figure may lie in the direction of developments now under study and experiment, such as the following: highspeed compressor for air conditioning directly connected to a specially designed driving motor; a new type battery, such as a nickel-cadmium, having different internal resistance characteristics and lower ampere-hour capacity than that of the conventional lead battery now used; and inductor-alternator type generator, without commutator, brushes or collector rings, designed to produce three-phase a. c. current for conversion by means of a rectifier to d. c. at the desired voltage if it is found feasible to produce such a generator for an output of 20 kw. or higher.

"Lighter, Better and Cheaper"

Some responsible and recognized authorities contend that certain specific additional costs per pound of weight saved can be justified and paid for in new cars, but economic developments, including those of recent months, indicate to me that a new appraisal of the situation is necessary and that to retain black ink in the passenger service accounts requires that in some manner or other, overall costs of operation must be reduced, not increased, and that we in the equipment field should at least make every effort collectively to hold our own on the formula of lighter, better and cheaper" to which I referred during the meeting a year ago. The railroad equipment building and supply industry, taken collectively, is capable of applying the industrial know-how and utilizing the technological progress, improved tools and techniques required to hold down actual costs for the accomplishment of the desired ends.

Some part of this vitally needed economy should be derived from further passenger-car weight reduction. Shortened schedules are quite rapidly being introduced and, as speed means power, the value of having saved about 175 to 200 tons in the present modern representative passenger trains, consisting of, say, 15 cars as compared with equivalent trains made up of the designs of the 1920's is not difficult to visualize.

It is hoped and anticipated that our discussion here may, in due time, have the result of substantially widening this weight difference with corresponding benefits in the advancement of the passenger-service art of the rail industry.

Alloy Steels for

Welded Locomotive Boilers*

By H. L. Miller†

A review of the materials suitable for welded boilers, the welding procedures which should be used and the possible advantages of stronger materials

ALTHOUGH steam motive power has improved in design and efficiency the basic method used to fabricate the steam-generating units has remained practically constant for over 100 years. They have been assembled and held together by the resistance to shear of rivets and plates.

The fusion welding of plates came into use first in fireboxes when conditions of temperature and pressure became too drastic for the economic maintenance of fireboxes with riveted seams. With the improvements in firebox efficiency the working pressures of boilers have gradually increased until the loads on the rivets and plates in the outer shells have now reached and gone somewhat beyond the limits of economical maintenance for that type of construction.

In examining the oil-refining industry or some of the chemical industries we find operating systems involving combinations of temperature and pressure so different as to be impossible of even attempting if the required units were limited to the use of riveted or mechanical joining of the members. Fusion welding, and in many cases special alloy steels welded in assembly alone, have permitted the use of the temperature and pressure conditions required for the successful operation of these processes. The use of welded alloy steel for high-pressure high-temperature steam-generating units for turbines in both marine and stationary power plants has long been accepted as the common practice.

Riveted Boilers Obsolete

For a long time the railroad industry was the pioneer in calling on the metal-producing and fabricating industries for more and better materials, practices and designs. Then the automotive industry passed the railroads in the application of higher working stresses on materials and, in turn, was passed by the aircraft industry until the steam locomotive in its design expressed in pounds of weight per horsepower and allowed working stress was completely outstripped. Also, in thermal efficiency the steam reciprocating engine was pushed into the background.

True, we cannot lower the four-to-one ratio of the weight on drivers to the tractive force as long as we have to depend on the friction between the tire and rail for the application of our generated power, but we can improve the over-all, thermal efficiency of our locomotive in pounds of fuel and water per ton mile by utilizing higher pressures in the cylinders and probably going to steam turbines as prime movers because of their greater utilization of the expansive force of steam as compared with the reciprocating engine.

Increased pressures require thicker and heavier boilers which introduce still greater localized stresses on the already overloaded rivets and rivet holes. The only way to further progress in increased pressures in boilers and perhaps in economical maintenance at present pressures lies in eliminating the concentration of stresses in the riveted joints by welding the joints, and then going a step further by choosing higher-strength materials that are capable of operating under higher unit stresses than the ordinary carbon-steel boiler plates. Progress in design and materials and their applications has long been accepted in other lines and has made possible the present mastery of men over their surroundings. The riveted steam boiler has remained longer than any of the earlier institutions of progress, but it is already obsolete and should be out of the picture.

[Mr. Miller then introduced in his paper a brief history of the first all-welded locomotive boiler and the action of the American Society of Mechanical Engineers in issuing a supplemental code on welded boilers in 1943. This code, he said, covers the application of the regular SA 70 steel and also SA 201 sil. killed steel, SA 203 nickel steel, 204 molybdenum steel and 212 silico-manganese steel. He included a description of the procedure and technique used in building all-welded boilers at the Schenectady plant of the American Locomotive Company, a description of which appeared in the July, 1946, *Railway Mechanical Engineer*, page 339.—Editor.]

* Abstract of a paper and discussion presented at the twenty-ninth annual meeting of the Master Boiler Makers' Association on September 5, 1946, at the Hotel Sherman, Chicago.

† Railroad Sales Division, Republic Steel Corporation, Cleveland, Ohio.

Table I—A.S.M.E. Boiler-Code Specifications for Steel for Welded Locomotive Boiler Shells

Requirements For Plates One Inch or Over in Thickness

Type of steel	Grade	Carbon per cent	Mang., per cent	Silicon, per cent	Ten. str. lb. per sq. in.	Yield point, lb. per sq. in.	Min. elongation in 8 in., per cent	Other elements, per cent
SA 201 Car. Sil.	B	.27 max.	.80 max.	.15-.30	60-70,000	.5 tens. strgth.	1,550,000/ten. strgth.	
SA 212 Sil. Mang.	B	.33 max.	.90 max.	.15-.30	70-82,000	.5 ten. strgth.	1,550,000/ten. strgth.	
SA 203 2½ per cent Ni.	B	.20 max.	.80 max.	.15-.30	70-82,000	.55 ten. strgth. 40,000 min.	1,600,000/ten. strgth.	Ni, (2.00-2.75)
SA 203 2½ per cent Ni.	C	.25 max.	.80 max.	.15-.30	75-87,000	.55 ten. strgth. 43,000 min.	1,600,000/ten. strgth.	Ni. (2.00-2.75)
SA 204 ½ per cent Moly.	B	.23 max.	.90 max.	.15-.30	70-82,000	.55 ten. strgth. 40,000 min.	1,600,000/ten. strgth.	Moly. (.40-.60)
SA 204 ½ per cent Moly.	C	.26 max.	.90 max.	.15-.30	75-87,000	.55 ten. strgth. 43,000 min.	1,600,000/ten. strgth.	Moly. (.40-.60)
SA 225 Man. Van.	A	.18 max.	1.45 max.	.15-.30	70-82,000	.55 ten. strgth.	1,600,000/ten. strgth.	Van. (.08-.14)
(Not yet approved for welded boilers).	B	.20 max.	1.45 max.	.15-.30	75-87,000	.55 ten. strgth. 43,000 min.	1,600,000/ten. strgth.	Van. (.08-.14)
Suggested 4620 Ni. Moly.	C	.22 max.	.90 max.	.15-.30	75-90,000	.60 ten. strgth. 50,000 min.	1,600,000/ten. strgth.	Ni. (.35-1.90) Mo. (.25-.40)

Same Welding Methods for Alloy Steel

This brief review of the production methods in use has been introduced to give an idea of how the operations are performed. All of the methods and practices as to forming, welding, testing and stress relieving, as used in making boilers from SA 201 steel with 60,000 lb. per sq. in. tensile strength, would be used in welding alloy steels in the same general way, allowing for the differences in welding rods, fluxes and the variations in voltage, amperage and speed of welding which might be required for these other analyses.

Table I shows the chemistry and required physical properties of the four steels at present accepted for welded boiler shells. Also shown are the 225 manganese vanadium steel and a 4620 nickel-molybdenum steel which has some excellent properties for this type of work. All of the steels in this group can be welded commercially to meet the exacting requirements of the A. S. M. E. Boiler Code. Their chemical composition is such that no trouble should be encountered due to hardening in the welded zone in making the regular automatic welds and the only precaution necessary is to see that all tack welds are made sufficiently large and heavy enough to hold down the underbead hardness. All hand welding should be done with 100 per cent mineral-coated rods and automatic welding machine fluxes of the same type should always be used.

Table II—Chemistry Tabulation of One-Inch Plate Stock

Stock from	Group	Test no.	Chemical analysis C	MN	S	P	SI	NI	CR	MO	VA
C.M.ST.P. & P.	1	1	.178	.69	.033	.013	.22	.03	.01	.52	...
C.M.ST.P. & P.	1	3	.172	.75	.021	.022	.20	.04	.07	.42	...
C.M.ST.P. & P.	2	2	.264	.77	.036	.029	.22	.04	.04	.01	...
C.M.ST.P. & P.	3	4	.292	.71	.021	.012	.21	.14	.02	.04	...
Vanadium Corp.	4	5	.140	1.02	.040	.023	.26	.11	.06	.02	.09
Carnegie	5	6	.216	.75	.025	.024	.23	2.36	.16	.05	...
Republic	6	7	.213	.85	.022	.018	.28	1.86	.16	.37	...
Republic (ladle)			.21	.81	.029	.018	.25	1.83	.19	.31	...

Notch Toughness of Boiler Plate

At 300 lb. sq. in. pressure the temperature of saturated steam is 417 deg. F. The shell temperature should be around 400 deg. F. in a well jacketed boiler. Empty boilers in storage under winter conditions may reach winter temperatures as low as 40 deg. below zero. In this range of temperature a considerable variation in the toughness of plate is to be expected. The notch toughness of boiler plate is a quality that has been given very little attention by the boiler designers.

We have made a considerable number of notched-bar impact tests on various analyses of steel plates suitable for boiler shells. These tests were made on both as-rolled and stress-relieved materials and in the transverse as well as the longitudinal direction of the rolling of the plate. The testing temperatures were –50, 80, 212, and 400 deg. F. The test materials were one-inch plates, cut one inch wide by six inches long and notched with the standard Izod notch cutter, so that the thickness of metal below the notch was .900 in. Test specimens were held for one hour at the testing temperature before they were broken on the large size Charpy machine at Watertown Arsenal which has a striking force of 2,200 ft. lb. The highest value obtained during these tests was 2,060 ft. lb. and the lowest, 54 ft. lb. These two values represent the toughest material at 400 deg. F. and the most brittle material at 50 deg. below zero.

Table II shows the chemical analysis of the steels tested. They are examples of SA 212, 203 and 204 steels or silico manganese, 2½ per cent nickel and .50 per cent molybdenum steels, respectively. Samples of a 225 manganese-vanadium steel and a standard 4620 nickel molybdenum plate are included for consideration as desirable materials for welded boilers

Table III shows the physical test properties of these steels in the asrolled and also in the stress-relieved condition. The materials meet the A. S. M. E. Boiler Code Specifications for Class B and C steels.

Value of Notch Toughness

The notched-bar impact tests were made as a preliminary exploration in a rather new direction of testing to determine, if possible, whether such a test could be used by purchasers of boiler steel to insure getting a more satisfactory material. The failures of welded ship hulls during the war have been publicized and while it is readily admitted that faulty design and workmanship were responsible for the initial starting of these failures, it was also found that in most cases the steel plates themselves were very low in notch toughness, and cracks which started at weak points ran clear across plates in sharp breaks without stretching or deformation of the metal adjacent to the failures. A very large amount of research was done by the steel manufacturers and the Maritime Commission on the effect of variations in steel making on the notch toughness of ship plate and some improvements were made in this respect. Of course, the ductility requirements in boiler plate specifications are higher than those for ship plate and the stress-relieving treatments used on welded boilers should further improve the notch toughness of the Class B or C grades.

Table III—Tensile Properties of Plate Stock from Various Sources

Test No.	Conditions*	Yield point lb. per sq. in.	Tensile strength, lb. per sq. in.	Reduction, per cent	Elongation in 2 in., per cent	Elongation in 8 in., per cent
1	LAR	48,000	72,800	58.6	44.0	22.0
1	LSR	50,600	70,800	57.9	44.0	22.0
1	TSR	53,100	74,600	44.2	35.0	17.0
1	TAR	51,700	75,000	43.5	35.0	17.0
2	LAR	39,700	74,700	53.3	38.0	34.0
2	LSR	39,800	74,500	51.5	47.0	28.0
2	TSR	38,100	72,200	48.3	44.0	27.0
2	TAR	38,800	71,100	31.8	38.0	23.0
3	LAR	53,700	74,000	45.7	44.0	21.0
3	LSR	51,600	71,800	46.7	40.0	21.0
3	TSR	52,100	71,100	56.6	43.0	24.0
3	TAR	53,700	75,100	57.5	43.0	20.0
4	LAR	50,000	78,200	51.4	44.0	24.0
4	LSR	45,100	73,900	65.8	48.0	26.0
4	TSR	45,900	74,700	42.0	42.0	25.0
4	TAR	48,000	78,400	39.0	35.0	20.0
5	LAR	47,800	67,800	64.1	53.0	28.0
5	LSR	50,500	68,900	65.4	51.0	27.0
5	TSR	50,100	68,600	58.6	51.0	26.0
5	TAR	49,900	67,800	61.4	51.0	27.0
6	LAR	55,300	83,600	50.5	39.0	21.0
6	LSR	57,400	83,700	59.4	42.0	21.0
6	TSR	57,600	83,000	47.8	40.0	21.0
6	TAR	58,300	86,200	48.0	34.0	15.0
7	LAR	74,500	103,600	48.1	32.0	15.0
7	LSR	78,700	99,500	55.1	37.0	15.0
7	TSR	80,200	99,100	40.3	30.0	14.0
7	TAR	82,300	102,500	42.7	28.0	13.0

*L, —Longitudinal; T—Transverse.
AR—As received. SR—Stress relieved at 1,125 deg. F.
Longitudinal and transverse specimens machined to width of one inch by plate thickness of approximately one inch.

Several years ago we conducted tests on the staybolt fatigue machine to determine the effect of notch toughness on the rate of crack progression in staybolts. In these tests we found that notch toughness was a very desirable quality in staybolts. We even found that staybolts with a high Izod value would run longer after a crack was started than the more brittle staybolts starting without a crack. There has been plenty of other evidence that notch toughness in steel helps to prevent sudden failures.

The test results showed that all of the steels are relatively tough throughout the service range and that they are all more or less brittle at room temperature and also

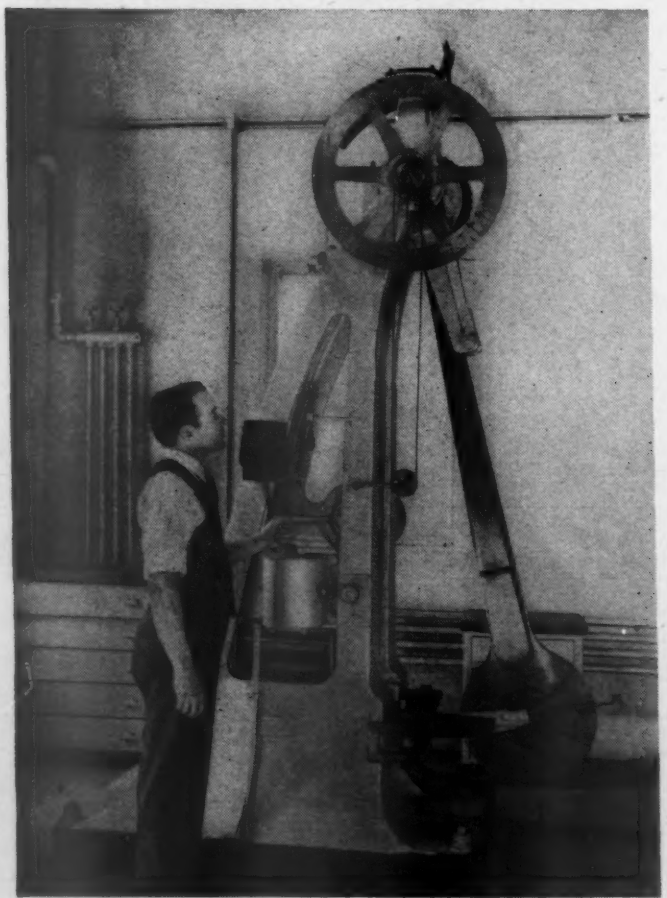
that at zero and 50 deg. below zero they are all *relatively* brittle in comparison to their toughness at higher temperatures. These tests results were obtained on only one plate from one particular heat in each different grade with the exception of the 212 and 204 steels.

Although there is a considerable difference in values between the samples of steels as found in this limited program, we cannot yet say that we are ready to recommend that this test or a similar one be adopted, nor are we ready to recommend any minimum values to be included in the test or that a tough fracture be required at room temperature. We believe that in the light of the fact that increased working stresses will tend to increase localized stresses, we should begin to pay more attention to the resistance of material to localized stresses and that some form of a notched-bar test will tell us more in this regard than any of the tensile or free-end tests used at the present time.

Stress Concentrations

The surface contour of the welds at the junction with the plate will be the principal point of stress concentration in a welded shell. The contours are also important where openings in the shell are made or where supports are fastened to the shell. A further program should be worked out on the fatigue strength of butt and lap welds and it should be undertaken to determine how much grinding down of weld beads and smoothing of bead edges is required to maintain a safe factor between the untouched welded joint and the fully leveled and ground weld area surface.

The welded boilers of SA 201 carbon steel now being built do not require the higher working stresses that will be used when alloy-steel boilers are designed. Going from a carbon steel of 60,000 lb. per sq. in. tensile strength to alloy steel of 75,000 lb. per sq. in. tensile strength will allow a 25 per cent increase in the working stress and, of course, a similar increase in concentrated stresses in the design unless these stress concentration points are reduced or eliminated in part by changes in the design of sections.



The 3,000-kgm. Charpy impact machine at Watertown Arsenal used in making notched-bar impact tests

A Way to Get Welded Alloy-Steel Boilers

Now to get down to consider what remains to be done to get lighter and more efficient welded alloy-steel boilers on locomotives. We know that the Interstate Commerce Commission must approve and issue a permit before a welded alloy-steel boiler can be built and operated. I would like to suggest that some railroads go about the matter in the following manner. When an order and permit to build a number of welded carbon-steel boilers is requiested, an additional boiler and locomotive of the same size and capacity but with an alloy-steel welded shell would be included in the request. The shell thickness would be the same in both types but the firebox staybolt spacing and other features of design be made in the alloy-steel boiler so that the working pressure could later be raised up to the allowed limit for the tensile properties of the shell and the cylinders bushed to a smaller diameter and with other arrangements necessary for higher pressure to be incorporated in the original design. Permission should be requested to operate the locomotive for a given period along with the others of the same type until the basic strength of the job has been proved and then make the changes in pistons in one or two stages until the maximum allowed working pressure has been reached. Changing equalizer ratings to throw more weight on the drivers would also be possible to maintain the factor of adhesion with an increased piston thrust.

This is one way that a gradual changeover might be accomplished without raising objections from the more cautious members of the railroad staffs and the Bureau of Locomotive Inspection, Interstate Commerce Commission.

I have no doubt that were it not for the laws governing locomotive construction, and the fact that rules and specifications for the welding of boilers were slow in development the welded boiler would long ago have been an accepted fact. But as long as the governing conditions are as they are, it really behooves us all to keep pushing forward by sheer weight of scientific knowledge and experience in order to make any progress in the improvement of the efficiency of the steam locomotive.

The idea of letting "George do it" has too long been prevalent both in the railroad and the supply fields. The rail industry is now faced with more serious competition than ever before and the steam locomotive with even greater competition from Diesel-electric units which now outnumber steam units about four to one on the builders' books. While I can hold no particular brief for either steam or Diesel, one over the other, it is not good policy for any nation to put all its transportation eggs in one basket. As long as we have both coal and oil, both should be utilized to maintain the economical transportation of freight.

Discussion by J. M. Hall*

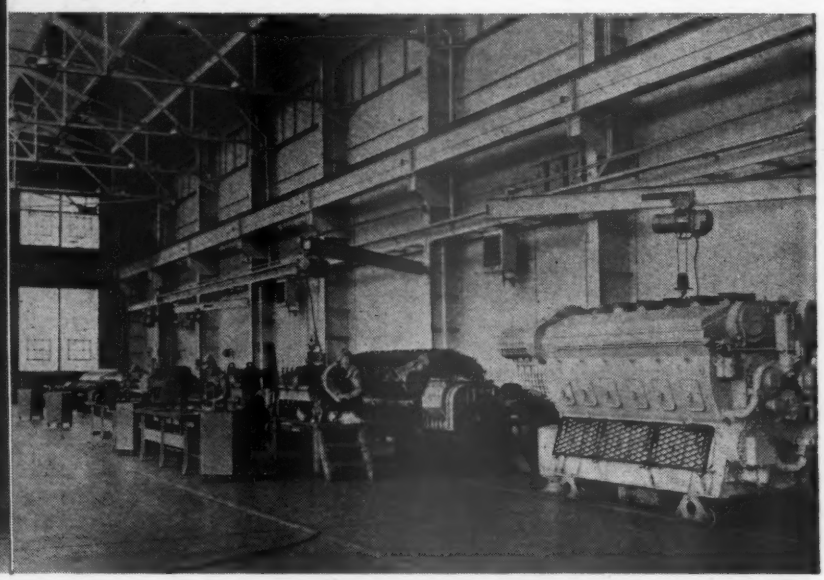
The description of how welded locomotive boilers are now being built is interesting and it should be noted that the procedures are the same as those followed in the pro-

(*Continued on page 15*)

* Director, Bureau of Locomotive Inspection, Interstate Commerce Commission.

West Burlington Diesel Shop

New facilities for making heavy repairs to Diesel-electric locomotives are complete with all machine tools and other shop equipment both for engine and electrical overhaul



Diesel engine test room with side and ceiling doors open (left)—Engine assembly stations (right)

THE new Diesel locomotive shop of the Chicago, Burlington & Quincy at West Burlington, Iowa, as described briefly in the December *Railway Mechanical Engineer*, is undoubtedly one of the best lighted, cleanest and most colorful shops of its kind in the entire country. In addition, it is provided with full equipment and trained personnel for making heavy repairs to Diesel motive power including the Diesel engines, electrical equipment, locomotive bodies, trucks and all auxiliary appliances.

The shop was constructed, as previously described, by partitioning off the 70-ft. by 792-ft. south bay of the old erecting shop to keep out dust and noise. A new floor was laid, with special foundations for all heavy machinery and large window areas installed in the south wall to give maximum daylight. High-intensity artificial light, giving a general illumination of about 20 foot candles on the horizontal plane, is installed, as described on pages 593 to 595, inclusive, of the November *Railway Mechanical Engineer*.

One of the unique features of this shop is the colorful interior, developed in conjunction with the Pittsburgh Plate Glass Company and designed to produce a color dynamics effect which definitely reduces eye fatigue and hence contributes to increased production, more accurate work, safer operation and less absenteeism.

The color scheme in this shop simulates an artist's dream, but results demonstrate its essential soundness. The upper side walls and ceiling are cascade blue; end walls, suntone; floor, cruiser gray; window trim, cameo blue, or parchment; traffic lanes, Dixie gray; material racks and lockers, red; machinery and benches, vista green; working parts of machines, focal buff; cranes, focal yellow; electric switches, control panels and mobile equipment, focal orange; guards or shields over gears, focal red.

The general effect is restful, interesting and highly agreeable. The favorable reaction on local shop forces may be judged by the fact that, after several months operation, this shop is practically as clean, orderly and well maintained as when new. The shop men themselves will not permit a newcomer to clutter or befoul the floor. They keep their individual machines clean and in some instances even waxed and polished.

Machinery and Shop Equipment

The major units of machinery and equipment installed in the West Burlington Diesel shop are listed in the table and their general location indicated in the floor-plan drawing. In addition to the machines mentioned, a large Lucas horizontal boring, milling and drilling machine, recently installed in the heavy machinery bay of the main locomotive shop, is also used for machining large Diesel engine crank cases, motor field frames, etc.

The principal machine in the Diesel shop itself is the Landis grinder equipped for grinding line bearings, crank bearings and axles. The Sellers 50-in. car wheel lathe

is designed for turning Diesel wheels with roller bearing boxes applied. The Bullard 54-in. vertical turret lathe is fitted with complete tool equipment for boring and finish machining Diesel wheels. Diesel axles are machined on the American 24-in. heavy-duty engine lathe. The large Magnaflux machine is used for testing crank shafts, axles, etc., and the smaller portable machine for testing miscellaneous parts.

Electric motor test work is greatly facilitated by the four Post-Glover stands and reostats for traction motors. The DeVilbis spray booth is equipped for cleaning traction motors and parts. The Elmes 400-ton hydraulic press is equipped for handling generator and traction motor armature work.

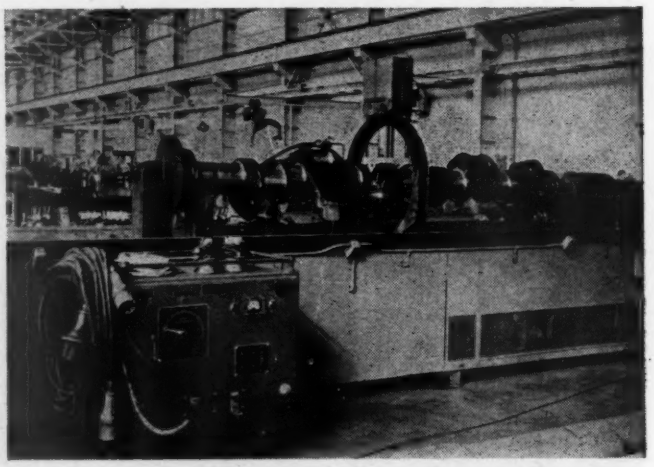
Two Gisholt Dynetric balancing machines are installed, one being used for balancing generator armatures, traction motor armatures and cooling rotors and the other for balancing small armatures. The Monarch 48-in. engine lathe is used for machining armature shafts, commutators, etc. Commutators are trued, mica insulation undercut and banding wire applied on the Peerless universal armature machine. The American 16-in. precision engine lathe and the Cincinnati-Bickford 21-in.

Landis crankshaft and axle grinder

vertical drill are used for small armatures and miscellaneous work.

The Niles journal lathe is used for turning the journals of mounted car wheels. The various shop departments and individual machines are well equipped with 28 Chicago Tramrail jib cranes and Yale & Towne electric hoists, including eleven 1-ton, twelve 1½-ton and five 2-ton hoists.

The two Westinghouse electric 400-deg. ovens are

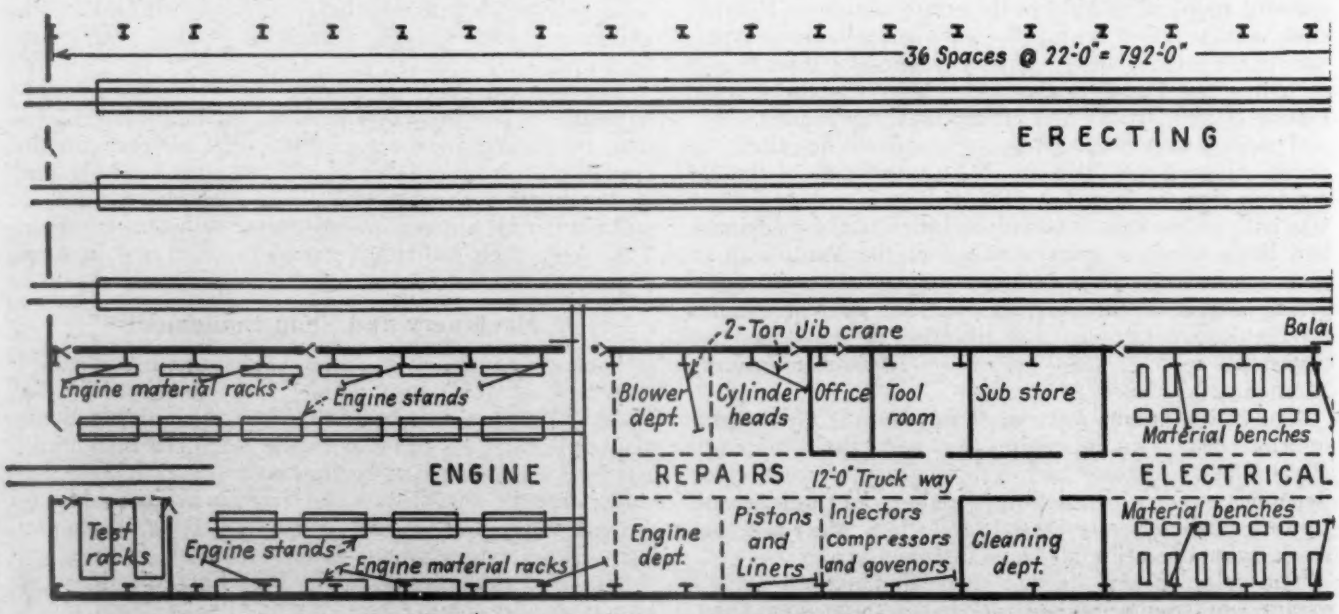


Magnaflux testing a large Diesel crankshaft

used for baking generator and traction motor armatures, cooling plates being equipped with motor-driven fans for

Machinery and Equipment in Diesel Shop, West Burlington, Iowa

40-in. by 200-in. crank-shaft grinder	Landis Tool Company, Waynesboro, Pa.
50-in. car-wheel lathe	William Sellers & Co., Inc., Philadelphia, Pa.
500-ton vertical turret lathe	Watson-Stillman Company, Roselle, N. J.
500-ton hydraulic wheel press	The Bullard Company, Bridgeport, Conn.
24-in. by 108-in. engine lathe	American Tool Works Co., Cincinnati, Ohio
5,500-amp. magnetic test machine	Magnuflux Corporation, Chicago
3,000-amp. portable test machine	Magnuflux Corporation, Chicago
Motor test stands (four)	Post-Glover Electric Co., Cincinnati, Ohio
Spray booth	The DeVilbiss Company, Toledo, Ohio
400-ton vertical hydraulic press	Elmes Engineering Works, Chicago
Dynetric balancing machine (7,000 lb.)	Gisholt Machine Company, Madison, Wis.
Dynetric balancing machine (75 lb.)	Gisholt Machine Company, Madison, Wis.
48-in. by 108-in. engine lathe	Monarch Machine Tool Co., Sidney, Ohio
Universal armature machine	Peerless Equipment Company, Chicago
16-in. by 78-in. precision engine lathe	The American Tool Works Company, Cincinnati, Ohio
21-in. vertical drill	Cincinnati-Bickford Tool Company, Cincinnati, Ohio
400-deg. baking ovens (two)	Westinghouse Electric Corporation East Pittsburgh, Pa.



Floor plan and layout of machine tools and shop equipment at the West

Machinery and Equipment in Diesel Shop—Continued

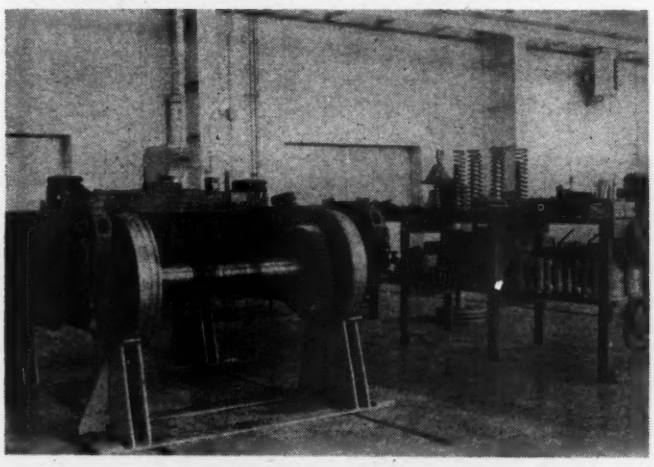
500-deg. baking oven	Young Brothers Company, Detroit, Mich.
Vacuum impregnator	J. P. Devine Manufacturing Company, Inc., Pittsburgh, Pa.
25-In. precision vertical drill press	Cleereman Machine Tool Co., Chicago
Niles journal lathe	General Machinery Corp., Hamilton, Ohio
Diesel valve grinder	Albertson Company, Sioux City, Iowa
Squaring shear, 36-in. foot-power	
Shaw 15-ton traveling crane	Manning, Maxwell & Moore, Muskegon, Mich.
Jib cranes, 28 (18 ft. radius)	Chicago Tramrail Company, Chicago.
Electric hoists, 28 (1, 1½ and 2-ton)	Yale & Towne Mfg. Co., Philadelphia, Pa.

MISCELLANEOUS PORTABLE EQUIPMENT

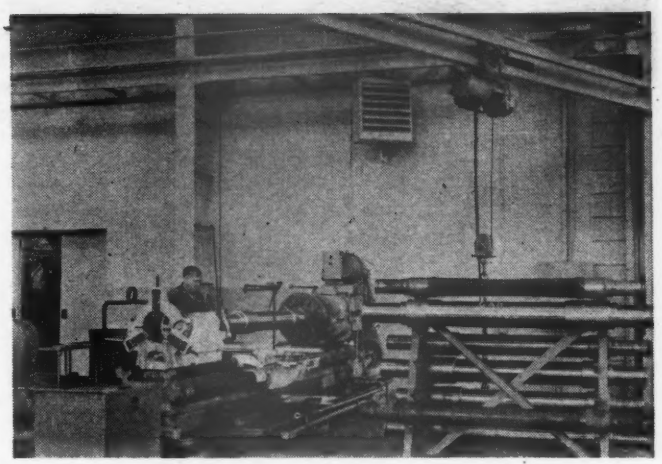
Axle generator tester	Surgercharger
Armature winder	Ignition condenser
Armature tester	Magnetometer
Field winder	Magneto test bench
Armature fault finder	Puller press
Coil spreader	Electric soldering pot
Coil taping machine	Traction motor gear heater
Electric grinder	Electric test set
Mica undercutter	Electric brazing machine

cooling the armatures after baking. The Young Brothers 500-deg. oven is of the single-compartment cabinet type for small armatures. The Devine vacuum impregnator, 60 in. in diameter and 60 in. deep, is equipped with a liquor tank, 8-in. by 8-in. motor-driven vacuum pump, varnish tanks and shop air pressure.

The Cleereman precision vertical drill is equipped with a compound table and used for general work in the cylinder department. The 36-in. squaring shear is operated by foot-power and used for shearing insulation required in the repair of electric generators and traction motors. The uses of other small items of equipment shown at the bottom of the table are self-evident.



Truck repair stand and material rack

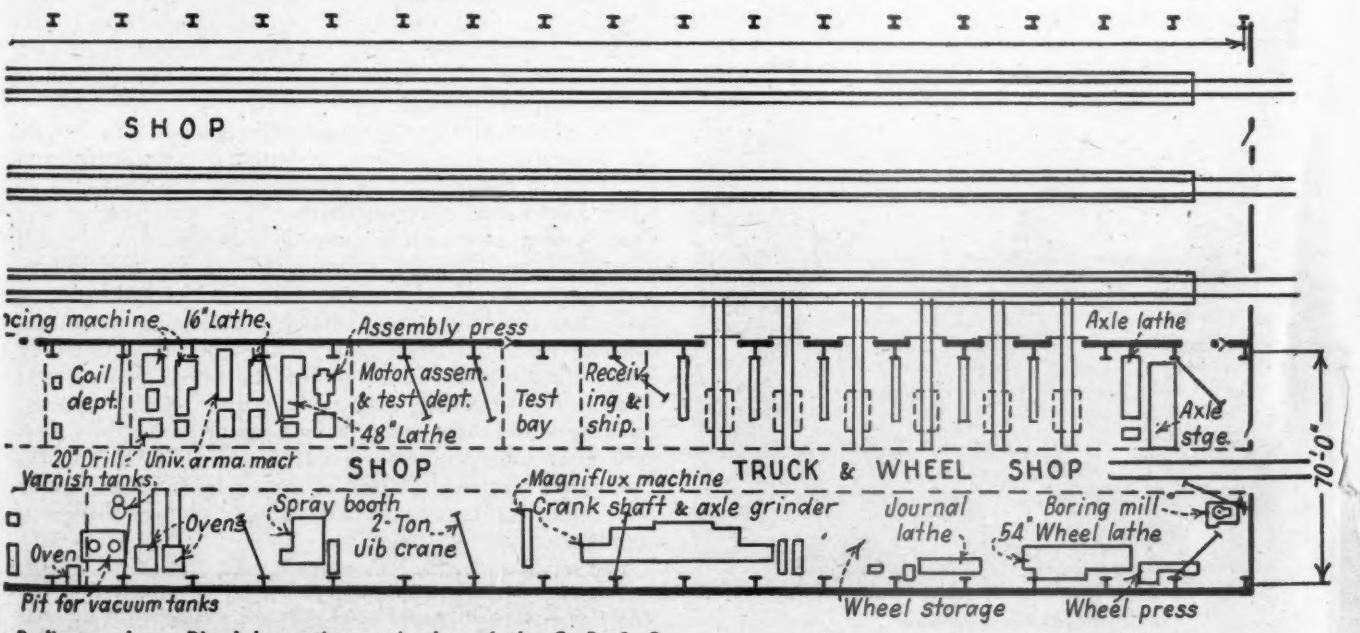


American 24-in. axle lathe and storage rack

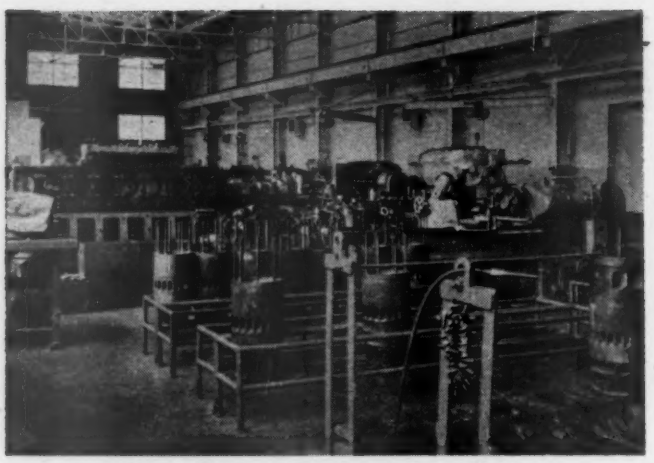
Diesel Maintenance Program

The Burlington's plan of Diesel locomotive maintenance calls for repairs based on the condition of parts at the time of inspection, which, in turn, is made on a mileage-operated basis. For example, pistons, liners, cylinder heads, and valves on road Diesels are changed out currently, as determined by their condition when inspected; traction motors, when new, are changed after the first 150,000 miles, and then at every 200,000 miles thereafter. On the other hand, in the case of Diesel switchers, the pistons, liners, bearings, etc., are inspected at the time of annual inspection and, if in good condition, are not changed. Charts, as well as other records, aid in keeping record of and controlling inspections and all types of repairs made to each unit, and show each individual work operation and the time completed. Through such charts, the work is done in the proper sequence and is fully co-ordinated.

All types of Diesel power on the Burlington are given heavy repairs at the new West Burlington Diesel shop,



Burlington, Iowa, Diesel locomotive repair shop of the C. B. & Q.



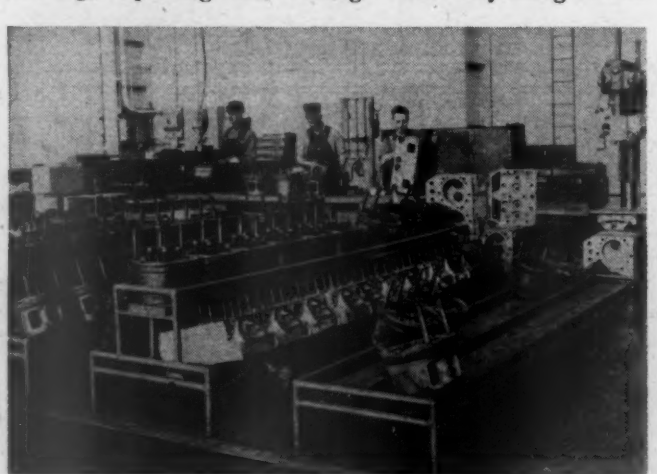
Diesel engine cylinder-liner-repair department

passenger Diesels being shopped on the basis of about 1,000,000 miles of service, switchers approximately once in seven years and freight Diesels at a total mileage as yet undetermined, owing to the relative newness of this type of power. All locomotives accidentally damaged to any appreciable extent are also sent to West Burlington for repairs. In addition, all materials and parts, removed from Diesel locomotives at other points on the Burlington, in accordance with the progressive maintenance program being followed by this road, are shipped to West Burlington where repair work can be done quickly and effectively.

These repaired and reconditioned parts are held at West Burlington, or shipped to outlying points, as necessary protection material to assure maximum continuity of locomotive service. The principal units of protective material include three 1,000-hp. E-M Diesel engines, two 1,350-hp. E-M engines, one 900-hp. Winton engine, one 600-hp. E-M engine, two D-8 electric generators for freight and two D-4 generators for passenger service, also an adequate supply of extra motors, truck parts, air compressors, etc.

General Arrangement of the Shop

The West Burlington Diesel shop is divided into four sections, each suitably equipped for the classes of work to be carried out in it, and an existing Shaw 15-ton overhead traveling crane furnishes lifting service for all sections. Starting at the west end, the first eight panels of floor area between columns are assigned to engine repairs, including inspection, dismantling, complete overhauling, repairing and testing. The adjoining seven panels are assigned as an auxiliary engine-repair section, and provide an office, tool room and sub-store area. The next 11½ panels are designated as the electrical shop, and the last 9½ panels are assigned to truck and wheel repair. No barriers of any kind separate the various sections, and all of them are served by a 12-ft. truckway. This truckway extends longitudinally throughout the center of the bay.



Cylinder-head department

The engine overhaul section is equipped to permit the dismantling, repair and assembly of engines. In addition to being served by a track entering through the west wall and extending 50 ft. into the bay, this section has two narrow-gage, engine-stand tracks, one on each side, which are joined through turntables at their east ends to a transverse narrow-gage track which projects into the erecting shop, under the working area of the heavy-duty traveling crane in that shop. Other facilities in the engine-overhaul section include eight of the 1½-ton jib cranes, with 18-ft. booms, arranged to serve the various engine stand locations in dismantling and assembly operations, and a fully enclosed, especially

Where fuel injectors and engine governors are repaired and tested

ventilated engine-testing room, 10 ft. by 22 ft., equipped with two test racks.

In the adjacent auxiliary engine-repair sections, the work handled includes the inspection and repair of cylinder heads, pistons, liners, pumps, injectors, governors, air brankes and other engine parts. Here, also, filters are cleaned and repaired, and for this purpose a large room is provided, furnished with cleaning, rinsing and oil-bath vats and an oven. Three other rooms in this area include a tool supply room, store room, and office for the Diesel foreman.

The electrical shop is completely equipped to handle the inspection, overhauling, re-winding, varnishing and repairing of motors and generators, and the repair of all other locomotive electrical parts. The west end of this shop is equipped with numerous work benches, a small grinder, varnish tanks, impregnator tanks, and ovens, while the east end, which is used as an electrical machine shop, has the power drill, dynetric balancing machines, banding machine, large and small lathes and assembly press, mentioned. This end of the shop also affords space for dismantling, assembling and testing motors, generators and their parts, being equipped with the necessary small tools and spray booth required for this work. The entire electrical section is served by a series of 1½ and 2-ton jib cranes to aid in the various handling operations.

The truck and wheel shop at the east end of the Diesel shop bay is given over entirely to the servicing and repair of trucks, wheels and axles. Like the engine-

overhaul section at the opposite end of the bay, this section is served by a 50-ft. length of track which extends into it from the east end of the building, and is also served by six transverse, standard-gage truck-repair tracks entering from the erecting shop.

How the Repair Work Is Handled

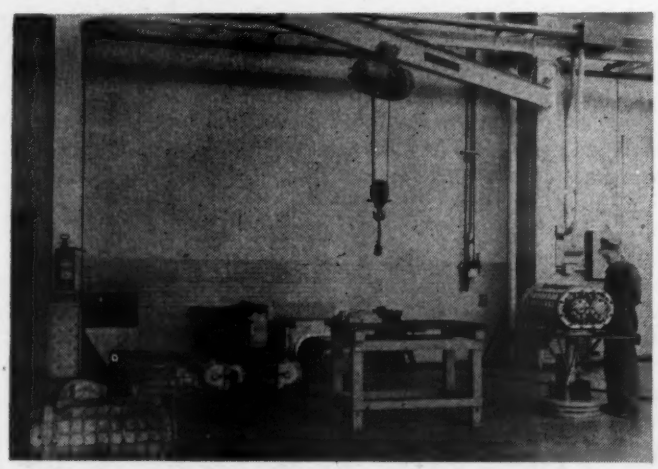
In repair operations at the West Burlington shop, Diesel locomotives are brought in on any one of the tracks of the erecting shop, where, with the aid of the 250-ton overhead traveling crane they are stripped and dismantled in accordance with the repairs scheduled. Main hatches are removed and any Diesel engine units to be overhauled are lifted out by the crane and taken to a point directly over the erecting shop end of the narrow-gage transverse track serving the engine-repair shop. Here the unit being handled is placed on a dolly, rolled into the Diesel shop and the engine spotted at the first of ten stations in the engine-repair section.

Eight portable engine stands, or assembly trucks, first applied at the third station, are an interesting welded steel design, 20½ in. wide by 52½ in. long, by 10⅝ in. high. The 1-in. by 6-in. welded bed frame is supported on four 2-wheel trucks, having 7-in. cast iron roller-bearing wheels which roll easily on the narrow-gage track. Each truck is equipped on one side with ¾-in. by 8¾-in. stop bolts and holding adaptors for various types of engines.

Work done at each of the ten stations in the engine assembly line includes the following:

Station 1.—Inspect crankcase; apply main bearings and check for alinement.

Station 2.—Prepare crankshaft for application; apply crankshaft; apply inner timing gear case.



Root blower repairs

Station 3.—Prepare lower oil pan for application; apply lower crankcase, sump cover, sump screen and portable engine stands.

Station 4.—Apply camshaft bearings, camshafts, injector control shafts, overspeed trip shafts.

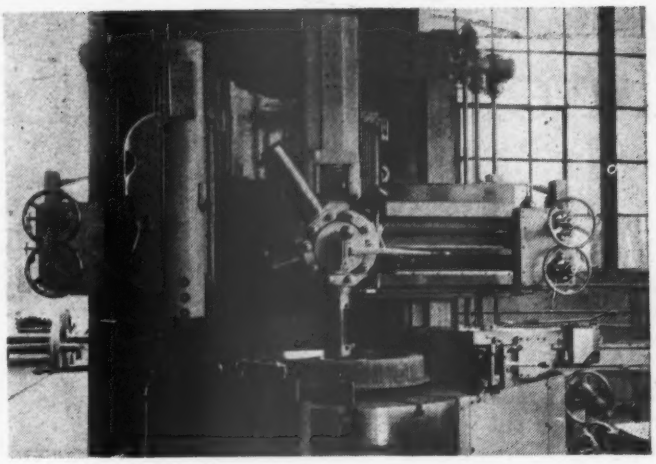
Station 5.—Apply pistons, liners, heads, connecting rods, connecting rod bearings, as units.

Station 6.—Apply piston-cooling pipes, lower back end sump cover, oil flinger, inner accessory drive housing, overspeed trip housing.

Station 7.—Apply timing gears, governor drive gear, accessory drive gear, harmonic balancer.

Station 8.—Apply lash adjusters, rockerarms, injectors; connect injector control arms, camshaft lube oil liners.

Station 9.—Apply outer accessory drive housing, outer timing gear housing, lower blower air ducts, oil separator.



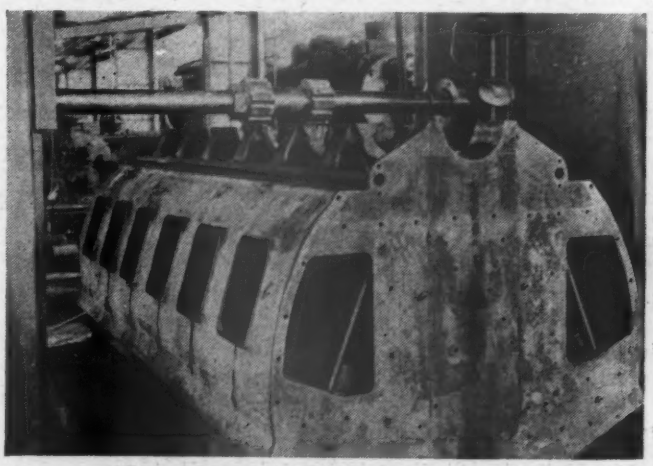
Bullard 54-in. vertical turret lathe used to bore Diesel wheels and turn them all over if necessary

Station 10.—Apply R-L blowers; R-L water pumps, lube oil pressure pump, scavenger oil pump, governor drive, governor, and pneumatic control, air strainers.

On completion of assembly operations, the engine is moved with the overhead crane directly to one of the two positions in the engine-test room, a hinged door in the ceiling being located over each position. With all electrical and pine connections made to the Diesel engine and both ceiling and side doors of the test room closed, the engine is given a full-load test for eight hours. It is then ready for painting and delivery to the locomotive.

Other parts of locomotives are handled in a more or less similar manner, being taken by the overhead crane to points where they can be moved readily into the various areas of the Diesel shop for further dismantling, repair and reassembly. As repaired, the various units or parts are moved back into the erecting shop adjacent to the wall separating this shop and the Diesel shop, where they are again picked up by the overhead crane and assembled on their respective locomotives. Frequently, to avoid tieing up a locomotive, spare engine units, motors, generators, wheels and trucks are substituted for those removed from any particular locomotive, and the locomotive is put back into service as quickly as possible. Repair operations continue on the equipment removed, which then becomes available for use on other locomotives as required.

(Additional illustrations and data covering operation of the Landis crankshaft grinder and Lucas horizontal boring mill on Diesel engine work will appear in a subsequent issue.—Editor.)



Cutting serrated bearings of a Diesel-engine crank case on the Lucas horizontal boring mill

Austria Revives

Fireless Steam Locomotives

By Dr. A. Giesl-Gieslingen, M.E. *

THE fireless steam locomotive in its conventional form where the accumulator pressure is hardly in excess of 300 lb. has usually been limited to operation in industrial and, particularly, chemical plants where fire prevention is the primary objective. The principal advantages of this type —namely, its ruggedness, simplicity and extremely low cost of maintenance—are accompanied by relatively small capacity and high steam consumption, limiting its use to switching service with moderate requirements.

With a view to extending the usefulness of fireless steam locomotives to heavy switching service and short-line traffic and at the same time raising its steam economy, the Vienna Locomotive Works in Austria have undertaken the development of high-pressure fireless locomotives for use in Austria† which have proved to be a substantial commercial success. The first experimental unit, built in 1934 for the Vienna Municipal Gas Works,

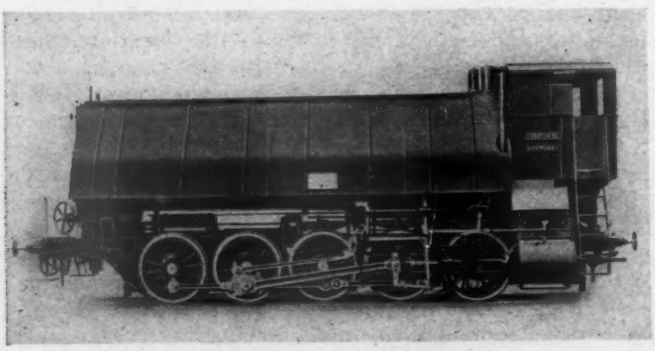


Fig. 1—High-pressure fireless locomotive built in 1934 for the Vienna Municipal Gas Works

was followed by almost 60 locomotives ordered between 1939 and 1944, although war conditions handicapped further extension after 1941.

The experimental locomotive shown in Fig. 1 was already designed for a storage pressure of 1,700 lb. per sq. in. and incorporated all the essential features which are characteristic of this development. In order not to sacrifice the basic simplicity of the fireless steam locomotive and also for thermodynamic reasons, the high pressure is used merely for storage purposes, while the maximum working pressure in the cylinders is that of a standard steam locomotive; namely, 215 lb. This means that constant admission pressure can be used over the major part of the working range of such a locomotive. The cylinders need not to be oversize as in the case of the conventional fireless engine in which very large cylinders are necessary to provide sufficient tractive force. Thus, a reasonably high mean effective pressure can be employed with resultant satisfactory thermal efficiency.

For those familiar with the thermodynamics of high-pressure steam, it will be evident that the mere throttling of the steam from the high accumulator pressure down to the working pressure would result in a high degree of moisture which would be detrimental to lubrication and to steam economy. Therefore, it is an essential requirement to dry the steam before admitting it to the cylinders.

This is accomplished in a very simple manner by installing within the high-pressure drum a superheating coil system. After passing the throttle valve the working steam which, as a result of the throttling process is cooled to a temperature of, say, 400 deg. F., is heated again to 500 or 550 deg. F. and enters the cylinders as superheated steam. The average steam consumption of such locomotives working with an initial pressure of 1,400 to 1,700 lb. has proved to be at least equal to a standard superheated switcher and amounts to little more than one half of the steam requirements of a conventional fireless locomotive.

In the experimental gas works locomotive a standard 0-10-0 freight engine had been used as a basis, while the conventional boiler had been replaced by three high-pressure drums. With a service weight of 182,000 lb., a maximum drawbar pull of 47,000 lb. can be exerted. Coal trains up to 1,700 tons are hauled from the railroad siding to the gas works, a distance of about one mile with a 1.7 per cent momentum grade.

In the later developed standard types of high-pressure fireless locomotives only one single accumulator or storage drum is used in accordance with improved manufacturing methods which made it commercially possible to produce drums of any required dimension. Fig. 2 shows a six-wheel engine of the most frequently used standard type having a service weight of 136,000 lb. and a tractive force of 34,000 lb. The storage space naturally varies with the pressure for which the engine is built. With an accumulator pressure of 1,200 lb., the hot water content is 433 cu. ft.; with 1,850 lb. pressure, 363 cu. ft. It is interesting to note that the heat stored in the steel masses of the drum adds in these cases 28 and 34 per cent, respectively, to the hot-water storage capacity, thus being a considerable factor. One of these engines with 1,200 lb. pressure is used in heavy coal and ash-removal traffic, pulling trains of 400 tons over a distance of 4.5 miles, encountering momentum grades up to 2 per cent. While negotiating this grade at 20 m.p.h., the indicated cylinder performance reaches almost 1,000 hp. The refilling of the accumulator requires only a total of 15 min. and in this service it is done from the power station boilers while the cars are being loaded.

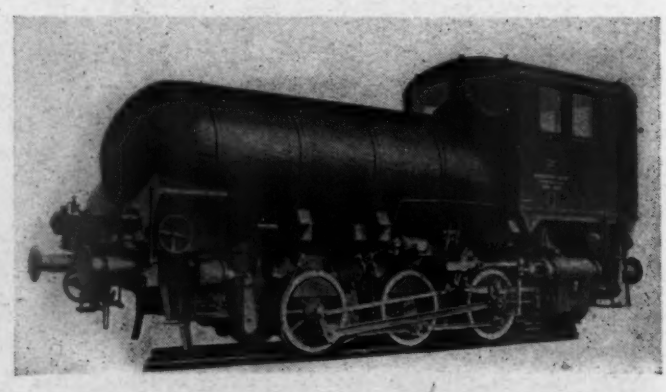


Fig. 2—A six-wheel high-pressure fireless locomotive (1943)

* Dr. Giesl's address is Hofenedergasse 3, Vienna II, Austria.

† The locomotive was developed under world rights handled by Ruths International Accumulators Limited, London, England, whose organization in the United States is Ruths Steam Storage, Inc., New York.

As will be seen from the illustrations, the locomotive cab has been placed relatively high above the rails so as to afford an excellent view in all directions. There is an operator's table in the center of the cab where the necessary handles, etc., are arranged in such a way that they can be reached by the operator irrespective of his position in the front, rear, or at the sides of the table. The engines are equipped with steam-operated standard air brakes and electric lighting by a turbo-generator. A special combination of high and low-pressure throttle with an intermediate receiver and an automatic reducing valve insures at all times a constant supply of steam to auxiliaries and for the starting of the main engine.

Experience has shown that, in switching service, such engines will usually operate four to six hours between rechargings and even the most intense heavy switching will not exhaust the steam supply in less than two hours. On the basis of the excellent operating experiences made with this type of locomotive a new field is opening in addition to industrial applications; namely, in large-scale terminal operation. It is very probable that engine terminals with a central steam supply for fireless high-pressure locomotives can be operated with unprecedented economy, both regarding first cost and operating expense.

Alloy Steels For Welded Boilers

(*Continued from page 8*)

duction of welded drums or shells of like material widely used in boilers of stationary power plants, none of which are subjected to the severe conditions of operation, such as vibrations to which all parts of locomotives are normally subjected, variations of pressure and variation of temperature as between different locations in the same boiler, the latter being akin to the causes of welded ship failures incidentally referred to in the paper.

In the introductory paragraph on the X-ray it is stated "After all welding on the shell including anchors for back head and front flue sheets . . . ." The use of the word "anchor" may cause some misunderstanding. If this word is intended to refer to brace feet or brace lugs it should here be said that brace feet or brace lugs are *not* welded in place as this practice is contrary to all generally recognized rules on welding of boilers.

The remainder of the paper is a plea for use of alloy steels of higher strength than that commonly used for welded boilers, apparently with two different purposes in mind: (1). A reduction in the weight of the boiler if the working pressure is not to be materially increased, and (2). the ability to carry higher pressure in a given size boiler of alloy steel as compared with a boiler of greater weight built of conventional materials; the higher pressure supposedly resulting in improved over-all thermal efficiency of such locomotives.

As to the first, a reduction in weight of locomotives or parts thereof, without a reduction in the potential power of the locomotive, has always been an appealing fetish to those not giving due consideration to the necessity of having an ample factor of adhesion to assure that the driving wheels will not spin when full power is exerted. The author has apparently recognized this feature but passes it over rather lightly. Some railroads, representatives of which are present at this meeting, reduced the factor of adhesion in the war period of such of their locomotives as were equipped with boilers capable of safely carrying higher pressure with the thought in mind that increasing the boiler pressure would increase the hauling capacity of the locomotive. This may have looked like a good move from the desk viewpoint but it in general was tragic in practice since it resulted in untold quantities of burned rails caused by the drivers slipping. You know that rails were and are difficult to obtain. In many localities these locomotives are locally and rightly termed "rail burners" and are not satisfactory over-all performers when the rail conditions are not close to ideal. They also tend to shorten the life and increase the failures of the rods and crank pins which, in turn, can be corrected only by redesign.

As to the second, the use of materially higher boiler pressures than those now common with locomotive boilers will necessitate compound cylinders if fuel consumption is not to be excessive. You know the reasons for the unpopularity of compound cylinders; these are good theoretically from the fuel economy viewpoint but locomotives so equipped have been found to be unduly costly to maintain and many of them have difficulty in running fast enough to meet modern requirements. Increased thermal efficiency is of course desirable but it is of much more importance for the railroads, and in fact essential if they are to escape public criticism and prosper, to have simple and reliable locomotives of high availability, than it is to attain the maximum thermal efficiency. The author also mentions the possibility of attainment of increased thermal efficiency by use of higher pressures and going into steam turbines as prime movers. This may be developed in the future for locomotives in services where long runs without stops or slow downs are prevalent but the boilers in all probability will not be of the conventional locomotive type.

In conclusion it would seem to be advisable that we approach the subject of higher-strength alloy steels than now used in welded locomotive boilers with considerable caution because of reasons which many of you will recognize without my going into details. Furthermore, due to the varieties of scrap now being used, it is becoming increasingly difficult to obtain boiler plate that does not contain unspecified and unwanted elements that introduce hardening qualities which are liable to cause early failure.

Other Comments

L. E. Grant, metallurgical and welding engineer, Chicago, Milwaukee, St. Paul & Pacific, and chairman of the Welding Committee, Electrical Section, Association of American Railroads, said that he was very much in favor of the welded boiler but wondered whether or not we had sufficient evidence to show that stress relieving is worthwhile. He told about the changes during the past few years in the attitude of the welding engineers with respect to stress relieving and among the welding profession he did not know of anyone who definitely knew that welding stresses were harmful.

W. G. Theisinger, assistant to vice-president, Lukens Steel Company reviewed briefly the steels being welded and suggested that the subject of alloy steels should be used as a basis for a larger investigation. He was convinced that stress relieving was both helpful and necessary and believed, furthermore, that X-rays are important.

F. P. Huston, research engineer, International Nickel Company, told of his early association with the welding of locomotive boilers and of attending the first meeting of the welding code committee of the American Society of Mechanical Engineers. He wished to impress the meeting with the fact that welded boilers are not new—all-welded stationary boilers have been made for years. With respect to the use of alloy steels he believed that new steels would be written into the code as they proved their worth.

EDITORIALS

Steam Power Shows New Signs of Life

As 1946 passes into history and we review railroad operation for the year, we find that several interesting developments have been revealed during that year in the field of steam power. By analyzing these developments there will be found many strong indications that the steam locomotive is far from obsolete.

Several railroads operating either brand new or comparatively new steam locomotives have found that this type of motive power need not necessarily be handicapped with either low mileage or high maintenance cost. The operation of large 4-8-4 type locomotives with a total maintenance cost of only slightly more than 13 cents a mile over a four-year period shows definitely that the steam locomotive is not inherently expensive to maintain. Groups of steam locomotives given selected assignments and adequate servicing facilities, both en route and at terminals, average over 25,000 miles a month. With boiler washes being given between runs, and annual inspection and repairs performed in two days, a locomotive remains in service virtually every day in the year, and can compete favorably on a mileage basis with any type of motive power.

Taking these new-found facts together with a long-standing advantage of steam power, namely that of low first cost per horsepower, it would seem that caution is indicated in the thinking of those who feel that the steam locomotive is on its way out. Nor should it be forgotten that the steam locomotive of present day design can easily pack more than 5,000 drawbar horsepower in four axles and 5,000 horsepower carries a lot of weight maintaining even the fastest and most rigid of schedules.

Too often, however, this schedule-making ability of up-to-date steam power units is nullified by time-consuming delays en route. This, along with far from perfect reliability, has often been considered a necessary evil of steam power. But both of these past faults can be eliminated if the facilities for servicing and repairs are as modern as the locomotive itself. Ash handling and coaling time must be kept to a minimum, with the coal quickly delivered and the dumped ashes rapidly removed if fast schedules are to be maintained. Repair costs can and have been reduced more than enough to justify modernization programs for shops having machinery that was never intended to maintain the high precision and high productivity required today.

The steam locomotive design of today is not static. In addition to innumerable minor improvements that are being continuously made, there are two major developments that appear destined to have a marked effect on future locomotive design. Welded boilers, which have already proven themselves practicable, should enable the railroads to make a substantial reduction in the cost of boiler repairs similar to the saving in machinery repair costs that has resulted from the use of mechanical lubrication, roller bearings, one piece beds, and lightweight reciprocating parts. The poppet valve gear may prove to be the answer to the problems of rising fuel prices and the rapid drop in horsepower that occurs in steam locomotives at high speeds. Thus it is apparent that the events of the past year, coupled with a look into the future, give a pretty strong indication that the steam locomotive will be with us for many years to come and that in the future it will give better and better service at lower and lower cost.

The Case for Head-End Power

"The modern railway passenger car is a fearful and wonderful thing." This statement, made recently by P. W. Kiefer, chief engineer motive power and rolling stock, New York Central, serves eloquently to describe the electrical equipment in particular. It may include axle- or engine-driven generators, inverters, motor-generators, batteries, lights, water coolers, fans, blowers, compressors, evaporators, refrigerators, sterilamps, electrostatic filters, "educated" air conditioning controls, and communication circuits for radio, public-address systems, wired music with or without program selectors, intricate switchboards and miles of wire involving circuits which only a skilled operator can follow.

There are three very good reasons why railroads should go to the use of "head-end" power to supply all of the electrical power needs of passenger trains. The first reason is that it would relieve the locomotive of a load of about 500 horsepower in the case of a 15-car train. The second is that it would materially reduce the complexities entailed by having an individual power plant on each car. Third it is possible that increasing electrical loads may make the use of axle generators impracticable and force the railroads to go to either head-end power or the use of relatively large internal combustion engines on each car.

Under present conditions, head-end power would require a power car equipped with engine-generator sets supplying auxiliary power to all the cars in the train through one or more power lines extending through all the cars with connectors between cars. The greatest difficulty confronting the use of head-end power is that cars are used in interchange. They must also be switched in and out of trains and they must be able to operate independently, at least for a short time. To fulfill the requirements of interchange would mean that all railroads use the same power system and have the

same type and location of connectors between cars. This seems like an insurmountable obstacle, since cars now in service are variously equipped with 30- and 60- and 110-volt d. c. power systems, some of them having conversion apparatus for producing 110-volt single-phase a. c. and 220-volt, three-phase a. c. power.

The situation presents a problem more complex than that of the standard coupler, but it would not be insuperable if it became a necessity. Pressure of circumstances has created a demand for it, and it would appear that railroad representatives should jointly give it consideration. They should first try to determine if head-end power is to be an eventuality and, depending upon their conclusion, either drop the matter or work out ways and means of doing something now which will be much more difficult to accomplish at a later time.

An Added Incentive for Better Counterbalancing

As is the case with all things under the jurisdiction of the mechanical department of a railroad, there are two aspects to the problem of counterbalancing locomotives. The first, or engineering aspect, appears to be pretty well solved. Past experience and test data have resulted in railroads being able to design and build locomotives capable of operating at present-day speeds with no appreciable damage to themselves or to the right-of-way. But the second, or economic aspect, has one factor bearing on a large group of locomotives which has not received the attention it deserves.

Most new locomotives built in the past ten years, and virtually all locomotives, both old and new, that are used in high-speed passenger service, have been counterbalanced with a high degree of refinement. Older locomotives, however, are not often balanced scientifically. These locomotives, particularly those from 10 to 20 years of age, perform a very substantial portion of the total locomotive mileage; yet many were designed and counterbalanced during and for an era of lower speeds than those at which they are today called upon to travel.

From such inadequate counterbalancing arise many harmful and costly effects that are well known to men responsible for the maintenance of motive power. Among these universally recognized effects is out-of-round driving wheels. It is the saving attainable through eliminating this condition that has gone largely unnoticed.

The necessity for dropping wheels between shoppings can be eliminated if the wheels do not become out-of-round. Various types of portable apparatus are available to maintain the proper tread contour with the wheels in place on the locomotive. These apparatus are designed to correct all defects of contour with the exception of out-of-roundness. Thus, by keeping wheels concentric, a locomotive will not have to be removed from service to have its wheels dropped. Its availability can thereby be increased and its maintenance cost reduced.

It does not, of course, follow that the saving to be realized from not having to drop the driving wheels for tire turning will be sufficient in itself to justify an extensive program of complete recounterbalancing, including the application of light-weight reciprocating parts. Nor, perhaps, does it even follow that a partial modernization is called for on the basis of this one saving. The subject is raised merely to point out that it is a factor which should not be overlooked when consideration is being given to the general problems of maintenance and availability, and to the particular effect that counterbalancing has on these problems.

Maintenance Standards

After making a comparison of the causes of locomotive failures that were presented at the September, 1946, meeting of the Southern & Southwestern Railway Club one wonders if there is not more than a little truth in the oft-made statement that the steam locomotive would make a better showing if it received the same degree of care and attention that is now given to the Diesel-electric locomotive. This point is not raised with the idea of detracting one whit from the excellent performance of the Diesels or to hint that they should receive any less care and attention than they are getting but rather to suggest that the steam locomotive could use advantageously better workmanship and greater precision in the manufacture, repair and maintenance of its component parts.

What caused the locomotive failures? For the most part the causes of steam locomotive failures reported at the meeting could be placed under the general classification of poor workmanship; those of the Diesel under that of poor or inadequate lubrication. Hot boxes, broken motion-work parts, broken pipes, improper tire applications and defective boilers causing steam-locomotive failures can usually be attributed to a lack of the high quality of workmanship required for the production of dependable machinery. They are symptoms of inherent weaknesses in repair and maintenance procedures. Lubrication difficulties in the Diesels can be overcome by relatively simple changes in operating and maintenance methods.

The statement was made, in the discussion at the meeting, that few major improvements have been made in the steam locomotive in the past 30 years. Without challenging that statement here, and there is plenty of evidence available to make its truth questionable, it can be said that the steam locomotive does not need a major improvement, as such, to eliminate a large proportion of the causes of failures reported at the meeting. No improvement in basic design would automatically compensate for poor workmanship used in machining, assembling and maintaining any locomotive part, whether steam or Diesel. Of the two types of motive power the steam locomotive probably should get more care and attention because it is subjected to additional stresses resulting from the action of unbalanced forces and from expansion and contraction due to temperature changes—conditions not found in the Diesel.

That well-designed and well-built steam locomotives will respond to good treatment and the right kind of attention has been proved by the outstanding operating performances being turned in every day by modern steam power on many railroads. They will keep on doing a good job only as long as they continue to receive attention comparable to that given to the Diesels, whether it is in workmanship, in the quality of replacement parts, or in servicing. When that standard of care is lowered, failures can be expected to increase.

1946 A Big Year In Shop Programs

The year 1946 started out to be a record year in the buying of machine tools and shop equipment by the railroads but it finished up by being a year in which buying was not as great in the number of orders but which, as in the previous year, exceeded most of the pre-war years since 1928. Those retarding factors which stood out most prominently were the great increase in operating expenses as a result of increases in wages and cost of materials; the unsettled policy with respect to shop rehabilitation programs on the part of many roads because of an inability to come to a decision with respect to the extent to which steam locomotive repair facilities should be modernized and, finally, the allocation of capital funds by management to those items of greatest need and on which the investment return was most favorable.

Foremost among the actual orders for machine tools and shop equipment during the past year were many thousands of dollars worth of new tools badly needed by the roads for car wheel shops and the modernization of locomotive wheel departments as well as the equipment for the several new Diesel-electric locomotive repair shops that have been built to take care of the rapidly growing fleets of this new type of power.

An important fact disclosed as a result of a survey of the shop equipment buying of railroads representing more than 80 per cent of the route mileage of the United States was the question of what the railroads would do about second-hand defense plant equipment. After the last war some railroads acquired considerable used machinery and their experience with that equipment was so unsatisfactory that apparently the memory of what happened 25 years ago had an important influence on the hesitancy in acquiring used tools after the close of World War II.

Those who sell shop equipment to the railroads quite frequently are told that a road is holding up its modernization programs because of the uncertainty as to the type of locomotives that may be used in the future. Some railroad officers seem convinced that, on their roads at least, no more steam power will be purchased. It is not possible, however, to overlook the fact that there are still 37,732 steam locomotives out of a total of 41,785 (3,372 being Diesel-electric and 704 electric locomotives) on the railroads of this country that are going to have to be maintained for years to come. While there are other contributing factors, there is no question that a part of the unfavorable costs of steam locomotive operation may have been due to procrastination in the matter of providing adequate shop and enginehouse facilities over a period of years. Many roads have followed a well-planned program of keeping up their repair facilities and it is more than a coincidence that the roads which have done this have effected economies in the operation of steam power that have placed them in a favorable position.

The Diesel-electric locomotive has brought into the shop picture a factor that is also resulting in some uncertainty as to future policy. This newer type of motive power has demonstrated to the railroads the value of a parts replacement system in repair work and because of the facility with which the manufacturers of this type of power have made it possible to secure repair parts, the question has arisen in the minds of many mechanical men as to whether or not the parts for the existing steam locomotive units could not more profitably be purchased on the outside instead of manufactured in company shops.

This is not a question that can be settled without considerable study for modern materials and quality workmanship are of prime importance in parts for high-speed service and if a railroad company's own shop can not produce these parts of material of the required quality and can not meet the standard of workmanship then the performance of power in service is quite likely to suffer. Engineering analyses should determine the most economical course to take and if parts required for modern locomotives are to be produced in company shops modern shop equipment must be installed.

NEW BOOK

CAR BUILDERS' CYCLOPEDIA, *1946 Edition. Published by the Simmons-Boardman Publishing Corporation, 30 Church Street, New York 7. Compiled and edited for the Association of American Railroads, Mechanical Division. 1,444 pages. Price, $6.*

This seventeenth edition of the Car Builders' Cyclopedia of American Practice follows the general arrangement of editions since 1922. Each of the 20 sections is clearly defined. Changes have been made in order to make the material more readily accessible. This edition contains a completely new section on car-shop layout and operation; wheel-shop design, equipment and operation; material handling; welding, and other phases of passenger- and freight-car maintenance. The Table of Contents by sections and subdivisions and the General Index to Car Parts and Products at the end of the book have been amplified, and a summary of the contents precedes each section. The book contains a dictionary of car terms, typical illustrations of railroad and industrial cars, their parts and equipment as well as data on cars built in America for export.

With the Car Foremen and Inspectors

Hot Boxes in Freight Service*

By H. R. Longhurst†

The first place to start in any endeavor to improve journal-box performance is on the repair tracks or in the car shops. If we are to expect 15 months of service under present conditions with high speeds, heavy loads, severe shocks in hump yards, and high car mileage, it is essential that the running gear of the car be mechanically right. All the requirements of Rule 66 should be closely adhered to. Journal boxes should be thoroughly cleaned and closely inspected, particularly the roofs of the boxes to see that they are in good condition. If distorted or worn hollow, it will make impossible the action of the crown on the back of the wedge in evenly distributing the load through the bearing to the journal. Inasmuch as bearings with liberal running clearance often operate with pressures exceeding 1,000 lb. per sq. in. of actual contact, it is essential that the wedge be permitted to distribute the load evenly over the length of the journal.

The A. A. R. report on the results of the recent journal-box-lid survey clearly indicates that more attention must be given to box lids. Of 2,671 boxes examined, 2,100 or approximately 80 per cent, had lids with less than 50 per cent contact on the face of the box. Certainly, journal-box packing cannot remain in serviceable condition for a period of 15 months without more adequate protection from dust, rain and snow. Missing or defective dust guard plugs must also be replaced. Occasionally boxes are found with a shoulder worn into the face of the lug to the extent that it is almost impossible to open the lid. This condition should be corrected before the car is allowed to leave the repair track. One source of frequent hot boxes closely related to the journal box is defective and improper refrigerator drains. These should be given close attention while cars are on repair tracks and corrective action taken whenever it appears that there is a possibility of water from the drains entering the boxes.

Wedge Condition Important

The wedge is an important member of the journal-box assembly and should be closely inspected, not only to see that the top is not worn flat for an area equal in length to the nominal journal diameter, but to see that its width is proper to protect the side of the bearing from longitudinal shocks transmitted through the inside lug of the box, and to see that the bearing side is true so that it can function in distributing the load evenly and without pinching the bearing.

Journal bearings should be thoroughly cleaned and closely inspected. The lining should be examined for cracks, spread lining or foreign particles that may have become imbedded. All bearings should be checked for loose lining before applying. This can be done by lifting the brass at the lug end, holding between thumb and forefinger, and lightly striking the back of the bearing with a hammer. Absence of a definite ringing sound will indicate loose lining. A little free oil should be put on both sides of the brass and on top of the wedge when applying to the journal box. Oily waste should never be used for this as particles of waste may remain on the bearing metal.

With the running gear and journal box assembly in good mechanical condition, the final step is to provide proper lubrication. Under present A. A. R. standards and specifications for oil, waste and renovated packing, there can be a vast difference in quality and yet comply with A. A. R. standards. The management of any road is reluctant to spend additional money in obtaining better quality oil and waste unless they have some assurance that other roads will do likewise. There is some hope for improvement in this matter in the recent A. A. R. committee report on lubricating practices. This report points out the fact that present standards are too broad and that there is no incentive to purchase better grades of material unless the betterment is made mandatory and applicable to all roads and equipment.

More Rigid Waste Specifications

Examination of manufactured waste prepared for different railroads clearly indicates the necessity for more rigid specifications. Some wastes contain a high percentage of short ends, shredded rags and shoddy threads, which give off excessive amounts of lint, rayon and other threads not suitable for packing. It is possible that, without the facilities of a testing laboratory or an inspector at the plant, one railroad might receive waste previously rejected as not suitable for packing waste by another road, and in turn repack the boxes of cars owned by the road rejecting the waste. It would seem that a competent committee could conduct a series of tests to determine the necessary specifications for a good quality of packing waste and the use of such waste made mandatory.

A few hours with the oilers in the transportation yard during the hot months of July and August, and during the cold months of January and February, will convince the most conservative that something should be done to obtain better qualities of oil. During the hot weather months, some boxes will be found with oil so thin that it goes to the bottom of the box allowing packing to expand and fluff to the extent that it cannot be kept in place under the journal, and as a result, rolls and works out from the back end of the box leaving from three to six inches of that portion of the journal with no lubrication whatever. During cold weather many boxes will be found with oil so badly congealed and so tacky that it is impos-

* Abstract of a paper presented at the November 4 meeting of the Northwest Carmen's Association.

† Assistant supervisor of equipment, Minneapolis, St. Paul & Sault Saint Marie, Minneapolis, Minn.

sible to get the cars out of the yards before the packing is badly rolled and, in some cases, actually pushing the box lids open, unless liberally free-oiled with a cut-back oil.

During the years directly preceding and during World War II, great strides were made in developing oils which would perform satisfactorily under most severe conditions. Much of this progress was made through the development and use of various additives. Of particular interest insofar as car oil is concerned are those additives which are added to an oil to improve the viscosity index, pour point and film strength.

While the quality of packing materials is largely a problem of management and the Association of American Railroads, there is much in the handling and application of the packing that can be done by the man in the

Spring packing retainer in modern freight-car journal box

field. Careless handling of packing barrels results in leaky barrels and poorly-fitted covers, and this in turn causes loss of oil and the entrance of grit and other foreign matter into the packing. Packing should be stored in warm buildings and turned, or surplus oil drawn from the bottom of the tank and poured over the top of the packing as outlined in Rule 66. Packing, however, should be chilled before applying to a cold box during cold weather. If moist, warm packing is applied to a cold box, the resulting condensation will cause packing to become frozen to the journal.

When applying the back roll, the packer should make certain that all loose ends are worked under and the roll shoved to the extreme back end of the box and firmly packed into place so that it will properly lubricate the back fillet and also keep out dust and dirt.

Rule 66 makes it optional as to whether packing is applied in the one piece method or in rolls. Regardless of which method is used, care should be taken to see that packing is applied as outlined and that it is applied firmly with all loose ends tucked under. Observation in train yards indicates that many boxes are not being packed firmly enough and, therefore, contain an insufficient amount of packing. This, together with the present design of round bottom journal boxes, results in rolling of packing even during summer monts, and, with no front wad to help retain packing under the journal, results in portions of the journal getting no lubrication.

It would appear that too much emphasis has been placed on keeping the packing one inch below the center of the journal and too little emphasis on seeing that pack- is firmly applied. While it is true that the higher the packing comes on the journal and the more firmly it is packed under the journal, the higher the friction and operation temperature, it is also true that sufficient packing must be had in the box to provide adequate lubrication in order to avoid complete failure. It would also appear that in this area where extremely low temperatures are not uncommon, further consideration be given to the use of a front plug.

It is clearly demonstrated each winter that, unless packing retainers are used, the packing cannot be retained back of the journal collar. In fact, it cannot be retained back of the collar during summer months. It will be found on inspection during cold weather that it is the rule, rather than the exception, to find the space between the face of the collar and the box lid pretty well filled with packing. The packing that moves out to fill this space leaves a large void under the journal where the packing is really needed. The front wad certainly would assist in retaining the body of the packing back of the collar.

Packing Retainers Help

Tests and actual service seem to indicate that packing retainers may play a very important part in improving journal-box performance. However, in order to make it possible to obtain real benefits through the use of retainers, their use must become universal through some form of encouragement by the A. A. R. and the journal box assembly must be in good mechanical condition, particularly dust guards and box lids. It has been found that a box packed with waste and oil of good quality, equipped with a good dust guard and tight box lid, and properly equipped with a good packing retainer can be run for a long period of time with no servicing necessary other than the possible addition of a little free oil. There is no doubt that if all boxes were equipped in this manner, there would be a sharp reduction in the number of hot boxes caused by waste grabs and lint wipes, now the major causes of hot boxes.

Each railroad and each yard presents its own problems in regard to train yard inspection and servicing. There are indications, however, that certain problems are quite common to all. For one thing, lack of sufficient time to properly inspect and service boxes, both incoming and outgoing, appears to be one quite common condition and one that no doubt leads to much of the servicing that is being done with a packing iron only.

Box Inspection and Spooning

It should be a preferred practice to make thorough box inspection and spooning immediately after the arrival of trains. Regardless of weather conditions, many boxes will be found with packing rolled up against the edge of the brass. Spooning this packing into place before switching will do much to prevent waste grabs caused by rough handling. During cold weather, boxes will

usually have sufficient running temperature to make it possible to readily spoon the packing, whereas, after becoming chilled it becomes very difficult to spoon. Further, any boxes with abnormal running temperature may be detected by feeling the journals and the boxes marked for later examination to determine the cause of the abnormal temperature. Here in the Northwest, we have two distinct hot box seasons. One, the period of extreme low temperatures and the other, the period of extreme high temperatures. Ordinarily, January and February are the two cold months and the number of hot boxes is apt to reach a maximum followed by a steady decline through the months of March, April, May and June. July usually brings a sharp increase in the number of hot boxes which continues through August. There is usually a sharp decline during the month of September and reaching a low for the year during the months of October and November.

During the months of January and February, some car oils become so badly congealed and tacky that packing rolls badly and the tacky oil pulls short ends and line from the packing and carries it up under the edge of the brass. Here it accumulates to form either an effective oil wipe, or, particularly with a sudden rise in temperature with the resultant thinning of the oil film, be drawn between the bearing and journal. In order to avoid a serious outbreak of hot boxes and the formation of the lint accumulations during the first and subsequent sub-zero spells, yard forces should be supplied with proper cut-back oil in advance so that as temperatures drop and the boxes with heavy and tacky oil can be detected, they can be free-oiled with an oil cut back sufficiently to reduce the viscosity and tackiness of the oil in the box.

Our records will indicate that, with the normal high temperatures of July and August, we can expect a sharp increase in the number of hot boxes, due largely to those boxes with very light oil which goes to the bottom of the box allowing the packing to fluff and roll. With the coming of warm weather, boxes in this condition will operate at a much higher temperature and, if they are inspected upon arrival and the journals touched by the inspector, the higher temperature should be taken as a warning that the box needs the addition of some heavier-bodied free oil.

Newly Employed Oilers

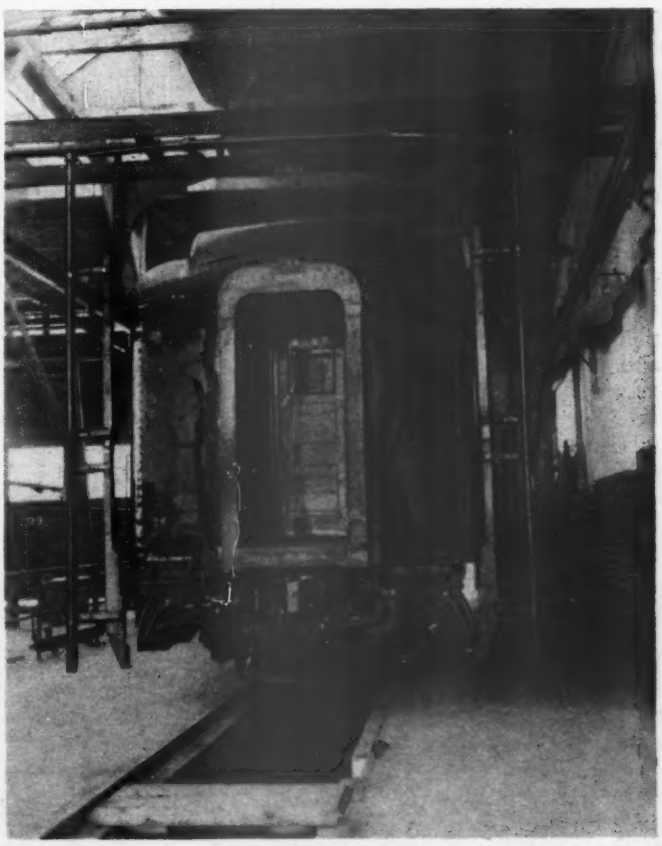
During the last few years, there has been a rapid turnover of help in the yards. Too many newly employed oilers with no previous railroad experience have been handed a packing iron and told to spoon all the boxes. They then have to learn the hard way and soon develop a system of opening box covers, jabbing at the packing and then closing the covers. Oilers should receive thorough instructions on the entire journal-box assembly, the common causes of hot boxes, and measures that can be taken to prevent failures. They should also be taught to readily recognize the box that does not require attention as well as to recognize the box that does, and the boxes requiring no attention should be passed up so that their time and efforts can be used to service the boxes that need attention. Proper instruction, coaching, and supervision will put the new man off to a good start with some understanding of the importance of his job and of the skill required to become a good oiler.

In conclusion, it might be well, inasmuch as a large percentage of the hot box trouble appears to be with foreign cars, to quote the first paragraph of Rule 1 of the A.A.R. Code of Rules. "Each railroad is responsible for the condition of all cars on its line, and must give to all equal care as to inspection and lubrication."

Checking Clearances On Canadian Pacific Cars

During the war a large part of the Canadian Pacific's passenger equipment was moved in troop trains to and from ports of embarkation in the United States. These operations required that all outside dimensions of C. P. R. passenger and baggage cars come within the clearance limits of the tracks over which they had to pass and, to determine accurately these demensions, this railroad designed and installed a special pit and clearance gauge at its Angus Shops, Montreal, Que. Since the war the installation has been continued in use because of the convenience and accuracy with which cars may be measured for clearance dimensions.

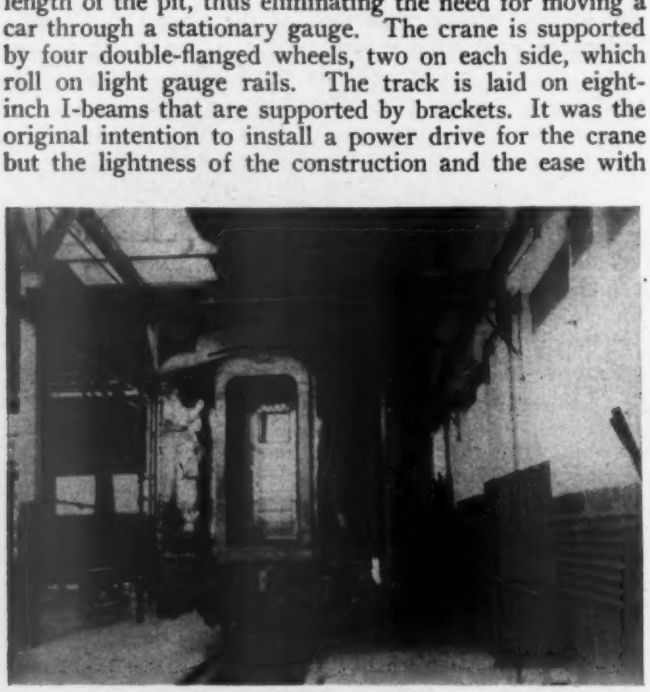
The pit is of concrete construction, 79 ft. long, 44 in. wide and 5 ft. deep, and is equipped with receptacles for electric lead lights in the side wall surfaces at intervals along its entire length. The five-foot depth permits men to walk without bending while inspecting the undersides of the cars. If it is necessary for the workmen to make adjustments to the running gear the pit side walls are furnished with holes into which cross pipes may be inserted for supporting scaffolding at a more convenient working level. Access to the pit is made by a stairway along the shop wall with a short connecting tunnel from the stairway to the pit underneath the shop floor. A safety gate is installed at the front end of the pit to prevent men from falling accidentally into the pit when it is not in use.



The clearance gauge in position prior to checking a car's dimensions

To insure the accuracy of the measurements the track rails for the pit were laid absolutely level and in addition the concrete floor on both sides of the pit was made dead level and flush with the top of the rails, the latter permitting heights of car parts to be measured correctly by using the floor as a base.

The clearance gauge is suspended from what is essentially an overhead traveling crane that was designed especially for the job so the gauge can be rolled the entire length of the pit, thus eliminating the need for moving a car through a stationary gauge. The crane is supported by four double-flanged wheels, two on each side, which roll on light gauge rails. The track is laid on eight-inch I-beams that are supported by brackets. It was the original intention to install a power drive for the crane but the lightness of the construction and the ease with



The clearance gauge moved part way down the car—Note the overhead traveling crane carrying the gauge and the stairway at the right leading to the inspection pit

which it may be rolled along the track by hand elimmated the need for power operation.

The crane structure has three crossbeams. The two on the outside are made of 1½-in. bl 8-in. wood stiffened by a 5/16-in. by 8-in. iron plate bolted to one side of the wood for its entire length; the center one is a 3½-in. O. D. pipe. Two cross braces of ¾-in. by 4-in. iron give the structure added rigidity. Two vertical 3½-in. O. D. pipes connected with the center crossbeam pipe by tees and extending down to about a foot from the floor on either side of the car supports the side clearance gauges. Each vertical pipe is braced at the center by two 2-in. pipes running diagonally to the ends of each of the outside crossbeams.

There are five separate sections to the clearance gauge, identified by the letters A to C, inclusive. The side gauges are made in two parts, the upper part being an A section and the lower part a B section. Each section is attached to the vertical pipes by two iron straps and two collars which have a sliding fit on the pipe and are supported by collars held in place on the pipe by set screws, an arrangement that permits the side gauges to be rotated away from the car and out of the way when not in use and prevents damage to them if they hit an obstruction.

The top gauge is made in a single piece but there are three different ones, C, D and E, each one having clearance contours that meets the clearance requirements of either the C. P. R. or foreign lines, the one to be used depending upon the service in which a car is to be operated. The top gauges are fastened by clamps to the center crossbeam pipe and when one gauge is swung down in a vertical position for use the others are rotated and clamped in horizontal positions out of the way.

In operation the gauge is moved down the track, usually by the men checking the car clearances on top of the car. It can also be moved easily from the floor by pushing on the vertical pipes and it is equipped with an electric bell, operated by a push button located on one of the vertical pipes, to warn men on top of the car before the gauge is moved. The level of the car is checked on the pit and the final levelling work is done at this location.

For each car a record is made of the trackage on which the car may be operated with safety and the parts that do not clear the gauge. For some car movements a part, such as a smoke jack, can be removed temporarily to permit the car to be operated over tracks normally restricted to the movement.

Testing Type AB Brakes*

By B. F. Grieshaber†

In cleaning and testing AB brakes on repair tracks in accordance with A. A. R. interchange rule 60, the following procedure is desirable.

(1) Each brake cleaner gang must be provided with a grease can, so arranged that both the grease and brush can be protected against dirt, one extra set of shipping covers for the service and emergency portions of the AB-vales, a blower hose, and suitable tools, such as: wrenches, scrapers and clamps.

(2) Record the car number, owner, and last cleaning date, if required for billing purpose. All old cleaning marks must be scraped off and painted over with quick-drying paint.

(3) Close the branch pipe cock, and drain the air out of the auxiliary reservoir, emergency reservoir, and brake cylinder. Remove the cup from the dirt collector, and leave it off until cleaned valve portions are applied. Disconnect the release valve lever.

(4) Blow any dirt or water out of yard air line and supply hose connections to car. Couple the yard air supply hose directly to the car brake pipe B-end, charge the brake pipe, and leave the yard air supply connected to it. Blow out the brake pipe by opening the angle cock at the A-end of the car, and then apply a dummy coupling, or the blower hose, to the A-end of the car, and leave both angle cocks open, open the branch pipe cock to blow dirt from the branch pipe, then close it.

(5) Scrape, wipe and blow off all dirt adjacent to the gaskets between the pipe bracket and the valve portions, then using the blower hose, blow off all loose dirt on the AB-valve portions, pipe bracket, hopper slope sheets, and car underframes that may otherwise get into the AB-valve portions or brackets when the portions are being removed and cleaned portions applied.

(6) Remove the vent protector from the emergency portion and apply a manufacturers standard vent protector plug, then remove the emergency portion, and immediately apply to it the spare shipping cover. The emergency portion must be carefully handled to avoid dirt, water or damage to internal parts.

(7) Remove the service portion and the brake pipe strainer and immediately place the strainer in the spare shipping cover, then apply it to the service portion. The service portion must be carefully handled to avoid dirt, water or damage to internal parts.

(8) Remove the caps and wasp excluder from the retainer, clean, oil, and replace same.

(9) Using scraper of suitable form loosen any dirt in the brake pipe passage strainer chamber, and other connecting passages of the pipe bracket, and then wear goggles when using blower hose with nozzle to remove

* Presented at the March 19 meeting of the Car Department Association of St. Louis.

† Air-brake repair man and test-rack operator, Illinois Central, East St. Louis, Ill.

any loose dirt and scale from the pipe bracket, strainer chamber and the branch pipe passages toward the open direct collector.

(10) When the valve portions are removed and conditions are found in the portions or the pipe bracket evidencing that the car brake equipment has been submerged in water, special additional cleaning operation, not regularly performed will be required, such as a piece of pipe bent in such shape as to syphon water from auxiliary reservoirs and emergency reservoirs after flange unions are removed.

(11) Before remounting the service or emergency portion on the pipe bracket, the body gaskets must be properly cleaned and carefully inspected to insure that they are in good condition. Gaskets which have flattened or broken beads, or any having cracks, or cuts, must be replaced with gaskets in good condition.

(12) With the service and emergency portion gaskets in place on the pipe bracket and fully seated, remove the shipping cover from the clean emergency portion and immediately mount the portion on the pipe bracket and after coating the threads with graphite grease tighten the nuts evenly and firmly. Clean or renew, if necessary, the vent protector; apply protector to the cleaned emergency portion. The shipping cover must not be removed from the cleaned emergency portion until prepared to mount the portion on the pipe bracket.

(13) Loosen the shipping cover on the service portion and, after removing the clean brake pipe strainer restore the cover on the portion, using a wood mandrel of suitable form for guiding the brake pipe strainer; place the strainer in the pipe bracket, make certain that the inner end is in engagement with the sealing bead (if properly inserted all nut threads will be visible); then apply holding nut and tighten it firmly with special wrench provided. Next remove the shipping cover from the cleaned service portion, and with the piston in release position, immediately apply the portion to the pipe bracket and after coating the threads with graphite grease, tighten the nuts evenly and firmly. The shipping cover must not be removed from the clean service portion until prepared to mount the portion on the pipe bracket.

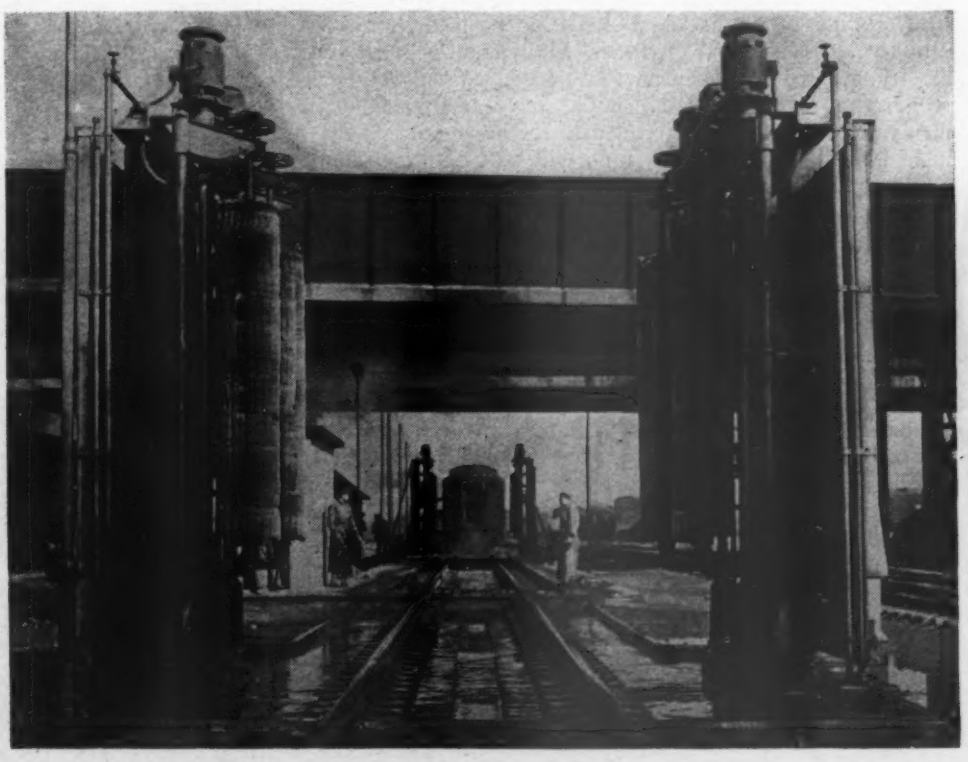
(14) Connect the release rod with a ¼-in. cotter. Clean and blow out the dirt collector dirt chamber, clean the check valve, renew if necessary, the gasket, then assemble using a small amount of grease on bolt threads.

(15) Disconnect and remove the brake cylinder push rod. To avoid personal injury, which may occur if the non-pressure head assembly is not secured by the hollow rod collar, examine the collar to determine that it will hold securely, then remove the piston, release spring and non-pressure head complete. These parts must be transported to a suitable shop for reconditioning. The piston assembly must be handled at the car, and while being transported to and from the car, so that the piston packing cup lubricator swab assembly and other parts will be effectively protected against damage and contact with any kind of dirt.

(16) If the non-pressure head gasket is unbroken and in condition to provide a tight seal do not remove it. If not, remove the gasket, clean its seat when cleaning the brake cylinder and apply new gasket, thoroughly clean the brake cylinder by first using a dully rounded scraper for removal of all grease and dirt, and wipe out dry and clean with rags or waste. When the cylinder is cleaned, prepare to immediately apply the piston and non-pressure head assembly. The lubricant should be applied to the cylinder just before the cleaned piston is installed.

(17) Using a suitable brush, coat the cylinder wall with brake cylinder lubricant. Place the non-pressure head gasket in correct position on the cylinder flange, coat the bearing surface of the packing cup and fill the grease groove of the felt swab with brake cylinder lubricant and immediately apply these parts to the cylinder and tighten non-pressure head bolts. Apply and connect push rod. Check the cylinder reservoir and pipe bracket for loose bolts, and tighten if necessary. The entire air brake equipment must be tested with single car tester, and then apply new date to car.

* * *



The Pennsylvania's Whiting tandem car washer at Chicago which has just washed one train and is ready for another—Either a cleaning solution or water can be supplied to the inbound washer in the foreground by remote controls from the control house

Locomotive Failures*

By James Grant†

THERE are two distinct causes of engine failures—man failure and material failure, but we find that the majority of our failures can be charged to the human element. Negligence, indifference, carelessness, and ignorance are all causes for engine failures, and this to some extent can be overcome by the proper kind of supervision and training of mechanics. Another method of improving operations is by the thorough dissemination of technical data to employees concerned about new developments in locomotives, machine tools, maintenance, and inspection techniques, and the specific instructions which every railroad issues. So many times this information only reaches the supervisory personnel, while in reality it is the man with the tools who must be informed if there is to be any real value derived from such information.

Materials Seldom Cause of Failures

Materials for locomotives are all ordered on well thought out specifications, and it is seldom that the manufacturer furnishes a piece of material that is not in accordance with the railroad's specifications. We often blame material for a failure; then when we check up the part that failed we may find where the part was not made according to the blueprint. Possibly the radius of the fillet was too small, maybe a sharp corner was left when there should have been a fillet, or a mechanic might have been careless and left a tool mark or nick in a piece of material, which is the start of a progressive fracture.

Improvement in design can prevent many engine failures. When a part breaks a sketch of the part should be sent to the mechanical engineer, who can often redesign or strengthen the broken part so that there will not be a recurrence. All railroads should have testing laboratories or have means of frequently testing materials furnished by manufacturers. This will pay dividends and save engine failures.

Good work in shopping engines will prevent many failures. In this day of high speeds, there is no place for shoddy work. This is where good supervision comes in. Do not under any circumstances sacrifice the quality of the work for the output of the shop because good workmanship will eventually pay off in decreased engine failures. Improved machine tools in locomotive shops have been a great factor in decreasing engine failures. No locomotive shop should be without a modern quartering machine—hot pins and broken rods decrease when wheels are properly quartered, the life of all vital reciprocating parts on the engine is materially lengthened, and failures are decreased.

Magnaflux testing machines are also essential in all locomotive shops. These machines detect cracks and flaws that the human eye cannot see. All reciprocating parts on locomotives should be Magnafluxed at each shopping, and more frequently should there be accidents or severe strains on any particular part of the locomotive. I also advocate Magnafluxing of the equalizers.

Metal fatigue is something else that should be closely guarded against. All vital parts of locomotives should have a predetermined mileage life, and this life should not be exceeded. It is much better to replace a part before an accident or a failure in service. Metals are no different from human beings—they deteriorate with age.

Just to illustrate the various failures, the causes, and degree with which they occur, let me give you a few figures on steam-locomotive failures on the Atlantic Coast Line for the first six months of 1946—11 per cent of the failures were steam failures, which were attributable for the most part to poor quality of coal and inexperienced firemen; 10 per cent were tire failures caused by improper operation of the brakes and by improper application of tires in the shops; 8 per cent were pipe breakages, usually caused by poor pipe work in the shops or enginehouses or by rough-riding engines; 12 per cent were hot or broken bearings; 15 per cent were defects in the boiler or firebox; 3 per cent were due to valves and boiler fittings; 4 per cent were due to crossheads and guides, and 4 per cent were broken rods and crank pins.

The road foreman and the engineman can be of great help in preventing engine failures; the engineman by operating the locomotive properly and carefully inspecting and reporting all defects; the road foreman by knowing his locomotives and firemen, instructing the latter in their duties, and by seeing that the rules and instructions are carried out. We generally find that a good road foreman has few failures on his territory.

Diesel-Electric Locomotive Failures

The first Diesel-electric locomotives were installed on the A.C.L. in 1939, and the road at present owns a fleet of 113 locomotives. We have learned much on the operation and maintenance of Diesel power since 1939, and every day some problem comes up on these Diesels which helps us keep down failures, and gives them the great availability that the builders claim for them.

Failures on Diesel locomotives can be held to a minimum provided the manufacturers' recommended periodic maintenance charts are religiously followed. These charts cover maintenance on all common parts where failures are possible. Nothing is too small or seemingly unimportant enough to warrant anything but the most minute inspection and care on a Diesel engine.

Proper lubrication is the life of a Diesel engine. If we have a lube-oil failure, then invariably an expensive

* An abstract of a paper presented before a meeting of the Southern and Southwestern Railway Club at the Ansley Hotel, Atlanta, Ga., on September 19, 1946. An abstract of one of the written discussions of the paper is included herewith. The other written and oral discussions of the paper will be published in abstract form later.

† Superintendent of motive power, Atlantic Coast Line, Waycross, Ga.

breakdown happens. Some of the lube-oil failures we encounter are: Michiana filters off their socket due to careless application by mechanics when cleaning and replacing them; foreign matter in piston cooling tubes, resulting in piston losses due mainly to mechanics allowing pieces of dirt and rags to get in the system; no oil pressure caused by dirty oil screens; oil lines in the rear of the engine working loose due to expansion and contraction; gasket failures, giving faulty gauge readings—these lines require frequent inspection at terminals to prevent these failures; water leaks at lower cylinder-liner seals due to sludge accumulation; dirty oil coolers causing improper cooling with low engine-oil pressure; failure to flush the engine out periodically, causing an accumulation of sludge and dirt; loose connecting-rod straps which allow oil pressure to drop on the crankshaft throw, causing crankshaft failures. There are many causes of lube-oil failures, but the main cures are cleanliness and good mechanical work and inspection.

Electrical Failures

Let us now go over just a few of the electrical failures. On the control system we find that improper adjustment of contacts in the throttle stand and lack of proper lubrication cause much trouble; electro-pneumatic contacts and power cut-off switches need careful attention; the interlock on unit switches and reverses requires frequent cleaning and adjusting and any number of other failures that can occur on these interlocks if not given the necessary terminal attention; loose connections in cables between Diesel units cause many delays unless carefully looked after; wheel-slip relay contacts must be inspected each trip to prevent constant wheel slippage with no indication to the engineer.

To prevent failures in the high-voltage power system the following are a few of the items that maintenance forces must carefully look for: Broken brushes, loose brush shunts, loose unit-switch contact tips, and low unit-switch contact pressure (caused by low air pressure). We have had failures caused by mechanics leaving pieces of locking wire in the engine room which got into the electrical system and caused grounds.

Some of the other troubles causing failures on Diesel locomotives are overheating of Diesel engines due to overloading, causing heads to crack; overheating of pistons causing cracks, and excessive expansion in gasket joints causing oil leaks. The operation of cold engines is another source of trouble. This causes poor lubrication with consequent troubles. Under no circumstances should a Diesel engine be put under a load until the required engine temperature has been reached; it is far better to delay the train until the engines are ready for full load. By doing this a costly failure will often be averted. Rough handling of Diesel locomotives by enginemen is something the road foreman should always look out for because many a ring-gear failure can be prevented by avoiding hard couplings and rough train handling.

[Several mechanical-department officers and supervisors present at the meeting discussed the subject of engine failures. S. D. Dekle, assistant chief mechanical officer, Seaboard Air Line, presented the written discussion included herewith in abstract form.—Editor.]

Discussion by S. D. Dekle

In the past 15 years we have had only an average of nine boiler failures each year for our entire steam-locomotive ownership. [Mr. Dekle included data in his introduction to show that boiler failures on the Seaboard totaled 402 in 1919 and decreased steadily to 14 in 1930, and 85 per cent of all of these failures were due to bad water conditions in the Florida territory. During the past five years, he said, 90 per cent of the boiler failures have been due to cinder cutting.—Editor]

If there are more mechanical failures resulting in train delays than there were in the old days of lighter and less complicated equipment, these failures are a challenge to the railroads to improve their maintenance and operating procedures so that a more favorable showing will be made. One step toward such improvement is the compilation of adequate records of failures and their causes. These data can be adequate only if they are the product of uniform and consistent procedure in recording and analyzing failures. If so prepared (and not tampered with for the sake of appearances) these records can be used to guide and measure efforts to renew those old traditions of on-time operation. In this way, various divisions on the same railroad can be encouraged to develop a healthy rivalry in reliable performance, and individual railroads can also make valuable comparisons with each other if they use the same terminology and the same measuring units.

In other words, on several railroads steam and Diesel locomotive miles per failure have decreased substantially in the past three years. This fact, in my opinion, should be accepted and the railroad men responsible instructed to remedy the situation instead of altering definitions and and figures in such a way as to make a favorable record on paper.

It is my belief that the engineers of our motive power have been lax when compared with automotive and aeronautic engineers. With a few exceptions, steam locomotives of today show very few improvements over those built 30 years ago, and the majority of improvements on the locomotives are those developed by the automotive or aeronautic engineers.

We have many failures of the valve gear, such as the valve stem breaking off at the crosshead or in the crosshead. Failures of this kind can usually be traced to the valve stem not properly fitting in the crosshead or to the crosshead not being in line with the valve-chamber bore. We have failures of the eccentric rods, combination levers and union links as well as failures due to radius rods breaking. In nearly all such instances we find an old progressive crack responsible for the failure. In all explanations of the engine failure, this cause is given but no attention whatever is paid to what caused the progressive crack to start in the first place. A study of broken valve-gear parts is usually traceable to a locomotive that has been out of the shop for some time and has considerable lateral between hub face of main driving wheel and driving box face.

A further study of broken valve-gear parts after the engine obtains, say, one-half inch lateral in main wheels shows a strain or bend of the eccentric rod due to the main wheels moving to the right and left sides as well as to close side lateral tolerances at the front and back ends of the eccentric rod. Such stress on the eccentric rod puts nearly all parts of the gear under a strain. To remedy such a condition a self-aligning bushing at both ends of the eccentric rod should do the job, if such a bushing is properly designed by our engineers.

We have engine failures due to hot driving boxes, trailers, engine-truck, and tank boxes; if they are mechanically perfect and properly packed these bearings will run without getting hot. We use a personal inspection after the locomotive is set out and supposed to be packed. In this way the trouble is forestalled in most cases as we find the boxes which are improperly packed.

Our failures of air pumps and air-brake appurtenances are kept low by inspection and test before the locomotive is offered for service. Our failures due to broken air

pipes on locomotives usually can be traced to pipes not properly clamped or to a locomotive being used with quarter flat tires so that vibration is set up.

We have lost a number of crankshafts on our Diesel power because of fuel oil in the lube oil or lube oil emulsified with water. In my opinion, a number of crankshafts also have failed due to bronze main-bearing shells. To correct these failures we are equipping our maintainers with viscosity gauges, and have asked the manufacturers to furnish us steel-backed bearings. We have also lost a number of crankshafts due to the connecting-rod strap breaking at the root of seration on rods finished on the shaper. To correct these failures we are scrapping the straps finished on shapers and use straps finished on milling machines, which leaves a radius instead of a square shoulder.

We have had some failures due to low main-bearing oil pressures, as well as high oil temperatures due to oil coolers and radiators being stopped up. To correct this condition we have put in a machine for both cleaning and testing coolers and radiators. In the event that the lubricating oil in the crankcase reaches a predetermined temperature of 235 deg. F. we have installed switches that will shut the engine down. (At 235 deg. F. oil viscosity is 60 seconds. Representatives of different oil companies tell us that this is the lowest reading at which lubricating oil is safe to continue operating the engine.)

We have had our share of trouble also on fuel-line assemblies; these fuel-line assemblies are being reworked in our shop and are being repaired by the application of sil-phos solder. We first sent them off to a company to test and see what was wrong and found the bronze solder was not going down around the collar and the pipe was just soldered around the top.

Slotting Eccentric Cranks

The illustration shows an efficient method of machining both slots in an eccentric crank at the same time by means of two tools properly spaced and bolted to the slotter tool post. These slots are required to give sufficient spring for bolting the eccentric crank firmly on the crank pin and, in the case of the crank illustrated, the slot on one side of the crank-pin hole is ¼ in. wide and on the other side ½ in. wide.

With parting tools spaced the correct distance apart, cuts may be started on the outer surface of the crank and the inner diameter of the crank-pin hole at the same time and proceed simultaneously until one is finished. The slotting operation will of course have to be continued until the longer cut is finished, but the short cut is net gain.

This time-saving machine-shop kink is now being used at the Paducah, Ky., locomotive shop of the Illinois Central.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Welding Longitudinal Seam on Welded Boilers

Q.—What are the requirements for the welding of a longitudinal seam of an all-welded locomotive boiler operating under the jurisdiction of the I. C. C.?—What efficiency is permitted for a welded longitudinal seam?—R. E. A.

A.—On the all-welded boilers recently built by the American Locomotive Company the welded seams had a tensile strength and elongation equal to or better than the parent metal and were obtained by following the Welding Procedure given in Section 9 of the A. S. M. E. Boiler Code rules. This procedure calls for the qualification of the welding technique of the shop involved and covers definitely the shop welding apparatus, electrodes, and plate materials. The methods of stress-relieving employed and the test specimens themselves must meet all

Cutting eccentric-crank slots with a double-tool arrangement in the slotter tool post

the requirements for Class I welding as covered in the Code for Welded Boilers for Locomotives.

After the shop methods are approved the qualification of individual welding operators is obtained by testing each welder who must follow the exact shop welding technique that has already been approved. The tests for welding operators are specially devised to establish the operator's ability to produce sound welds in the positions involved in the actual welding of the boilers. In so far as possible, down-position welding is arranged for and the smothered-arc type of machine welding extensively employed.

The foregoing was the ground work or preparation carried out before the job was started. Next, test specimens which must meet all of the requirements are furnished for each boiler. All of the strength welds are X-rayed and must show the required degrees of soundness and freedom from inclusions or porosity. After the welded boiler has passed the X-ray examination successfully, it is stress-relieved in a furnace of sufficient size to take the boiler as a unit. This furnace is under pyrometer control and shows a closely uniform temperature at all points. The test specimens are subjected to the same heat-treatment, preferably with the boiler.

After the firebox is applied and the boiler completed, a hydrostatic test pressure of 1½ times the working pressure is applied, and, under this pressure, all of the welds are subjected to a hammer test. Where the welding procedures in the A. S. M. E. Boiler Code rules are followed and all the requirements for Class I welding compiled with, the efficiency of the longitudinal seams may be taken as 90 per cent.

Riveting Domes to Tapered Boiler Courses

Q.—We are having trouble with leaky domes where they are riveted to the shell. Repeated caulking of the rivets and the edges around the dome and the renewing of the rivets give only temporary relief. This dome is located on the second course, which is a tapered course. Would uneven expansion and contraction due to the taper of the course set up stresses sufficient to cause this trouble?—K. J. F.

A.—The expansion and contraction through the structure should be uniform at this point and the variation in diameter from the front to back of the dome should have no effect on the tightness of the dome seam. The fitting of a dome is more difficult on a tapered course than on a straight course, and unless care is taken, an improperly fitted dome will result. All domes and liners should be properly formed, have true radii, and be set up with metal-to-metal contact. The maximum opening at any point should not exceed .005 in. nor should it extend over one-half the pitch between rivets. There should be no springing of the sheets into place, nor any drawing of the sheets together, to correct inaccurate fitting. With a properly fitted and riveted dome, no difficulty should be experienced in maintaining tight dome seams.

Copper Washers in Steam Pipe Connections

Q.—What is the purpose of using copper washers under the heads of the bolts connecting the steam pipes to the cylinders?—L. H.

A.—The purpose of using copper washers under the heads of the bolts connecting the steam pipes to the cylinders is to compensate for expansion in the steam pipes and cylinders. As the steam pipes are connected to the cylinders while the engine is cold, when the engine is under steam the expansion in the cylinders and steam pipes sets up a strain in the bolts holding the connection. The use of the copper washers is intended to cushion this strain.

Their use has been generally discontinued because the continual expansion and contraction of the steam pipes finally cause the bolts to become loose, thereby causing a leaky joint. The general practice today is to use bolts with sufficient tensile strength to withstand the strains set up due to expansion and contraction.

Variations in Plate Thickness

Q.—In computing the allowable working pressure of a locomotive boiler, is it necessary to make any allowance for variations in the thickness of the plate used, especially if it is under the thickness of the plate specified?—M. E. K.

A.—Most boiler plate specifications allow a tolerance of 0.01 inch less than the actual thickness of the plate specified. In computing the allowable working pressure, the thickness of the plate is taken without any consideration given to the allowable under-tolerance as permitted in the boiler plate specifications. The American Society of Mechanical Engineer's Boiler Construction Code has a provision that plate material not more than 0.01 inch thinner than that calculated from the formula may be used in code construction provided the material specification permits such plate to be furnished not more than 0.01 inch thinner than ordered.

Pneumatic Clamps For Stack Cutting

One of the essential requirements for satisfactory stack cutting of steel sheets and plates, now so widely done at railway shops, is to hold the plates firmly together while the mechanically operated oxyacetylene cutting torch follows the path prescribed by the template on the cutting machine table. The clamps are used in connection with an Oxweld 81-in. shape-cutting machine at the Paducah, Ky., shops of the Illinois Central and represent a design which gives unusually satisfactory service.

Since the steel sheets to be stack cut are frequently of large size, (up to 81 in. wide by 15 ft. long), three air clamps are installed to give positive clamping, one at each end and one at the center of the longest sheet. As shown in Fig. 1, the clamp *C* is designed with long jaws and mounted on a small four-wheel dolly truck which permits easily moving the clamp in and out with respect to the work-supporting table and applying pressure to the stacked sheets at any desired point from one side to the other. Moreover, the point of clamping may be easily changed as desired, dependant upon the progress of the cutting torch.

The construction of the pneumatic clamp will be apparent in Fig. 1. The clamp itself is made of two ⅞-in. steel plates, 26 in. wide by 72 in. long, separated 3 in. by welded spacing blocks and having a jaw cut out 6⅜ in. wide by 61 in. long. This clamp is suitably mounted on the dolly truck which is equipped with four 10-in. wheels and moves on a 19½-in. gauge track extending under the work table.

Mounted on top of the clamp is an 8-in. by 12-in. air-brake cylinder which accuates lever *L* having a fulcrum on pin *P*. The lower end of lever *L* is designed with a taper toe *T*, better shown in Fig. 2, which brings heavy pressure on the stacked sheets when the brake-cylinder piston moves outward.

Air is supplied to the brake cylinder from the shop air line through feed valve *F* and independent brake valve *I*, Fig. 1. Operation of this brake valve to re-

lease the pressure in the brake cylinder, of course, retracts the piston and releases the clamping pressure on the stacked sheets. The pressure developed by this clamp is great enough to hold the stacked sheets firmly together and prevent any possible movement during the torch-cutting operation.

When the clamp is applied to the outside edge of wide sheets, it is frequently desirable to clamp the inner edges which extend well within the jaws of the machine. To accomplish this, a bracket, better shown at *B* in Fig. 2, is applied to the clamp *C* and equipped with a small journal jack in inverted position which can be used through suitable blocking to hold the inner edges of the stacked sheets together. This bracket *B* is supported on two angles welded on either side of clamp *C*, the actual weight of the bracket and jack being carried on roller bearings for ease of moving on the clamp. The jack base is bolted to the bracket in an upside down position (Fig. 2), and the sides of the bracket are flanged at the bottom to extend under the angle on each side and thus hold the bracket and jack against upward movement when pressure is applied against the stacked sheets. This bracket has 14 in. travel along the clamp to permit locating it where pressure is desired on the sheets underneath.

The construction of auxiliary hand clamps required in holding the edges of stacked sheets together is clearly shown in Fig. 2. The hand clamp *H*, for example, consists of a light double-plate construction with hinged lower jaw tightened or released by operating handle *O* through suitable wedging action.

The thickest stack of steel sheets which can be held with the hand clamps is 4 in. and usually consists of twelve $\frac{5}{16}$-in. sheets. Stacks of sheets up to 6 in. thick can be held with the pneumatic clamps. By the combination of pneumatic and hand clamping, it is possible to hold the edges of stacked sheets in close contact and thus assure smooth, accurate work with the machine.

Fig. 1 — A truck-mounted pneumatic clamp for holding stacked sheets on the Oxweld shape-cutting machine at the Illinois Central shop, Paducah, Ky.

Fig. 2—The three pneumatic clamps, and hand clamps used on the Oxweld machine—A long cut on twelve $\frac{5}{16}$-in. sheets has just been completed

ELECTRICAL SECTION

Maintaining Waukesha Equipment

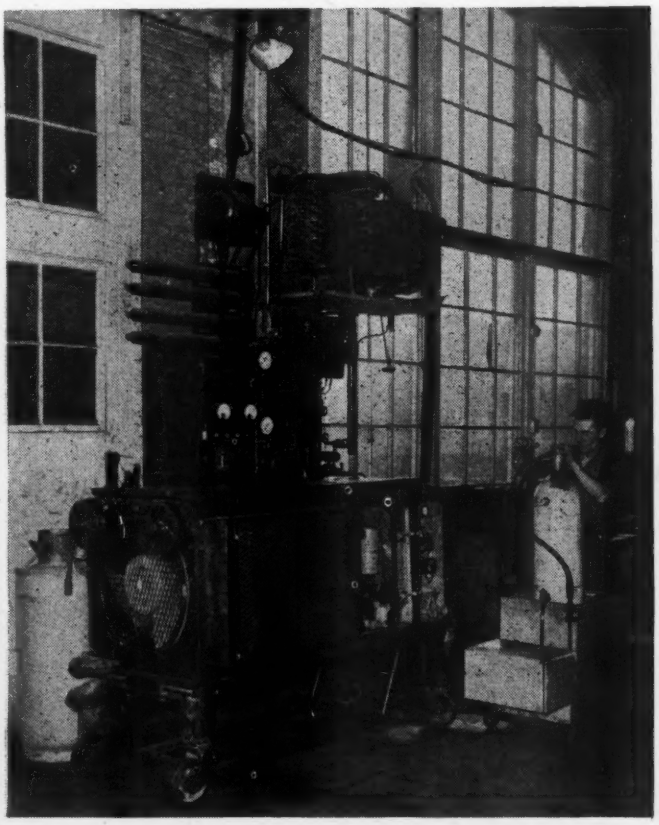


Fig. 1—Ice engine unit being tested at Los Angeles General Shops

Southern Pacific can rebuild an ice-engine or engine-generator in seven days—Maintenance schedules are arranged to insure year-round operation of its four repair shops

THE Southern Pacific Company is now maintaining an overhaul program for Waukesha air-conditioning and engine-generator units based on the time units are in service.

Sufficient spare units are available so that units can be exchanged quickly and repair work so arranged in any one of four overhaul shops for Waukesha units to permit a complete rebuild job in seven days.

At present, the Southern Pacific is maintaining a total of 192 ice engine units and 92 engine-generator units. Each ice-engine unit is brought into the shops every twelve months for a complete overhaul and the engine-generators every nine months with the exception of Waukesha equipment on the cars in the Streamliners "City of San Francisco." Due to all-year cooling service on these trains the overhaul periods are six and three months respectively. Furthermore, some of the units are located under the car center sill where heat and dust conditions are severe resulting in excessive wear of parts.

The air-conditioning or ice-engine unit, when brought in for overhaul, is completely stripped down to the frame. The frame is then sand-blasted and painted. All parts of both engine and compressor are disassembled thoroughly cleaned, shafts and rods magnafluxed, and old parts replaced or repaired. After the unit has been reassembled and painted, it is placed on the test rack and given an 8-hour test run under load conditions.

Figure 1 shows an ice engine unit being tested at the Los Angeles general shops. At the extreme right is a portable wagon for moving a tank of freon gas. This tank is being used as a receiver for pumping freon from the unit on test. A pump circulating ice water keeps the pressure at a minimum. This arrangement can also be used for transferring freon from one cylinder to another by the transfer method, and readily separates the oil from the freon gas.

All four overhaul shops are completely equipped with various testing devices to insure all parts of the equipment are in proper operating condition when the unit is placed in service. Figure 2 shows a close-up of both the test equipment for the ice-engine as well as the engine-generator unit. Figure 3 shows one of the benches where the engines are overhauled. Note engine crank case holders, which can be adjusted to hold the crank case in any position. The crank case can be rotated fully when

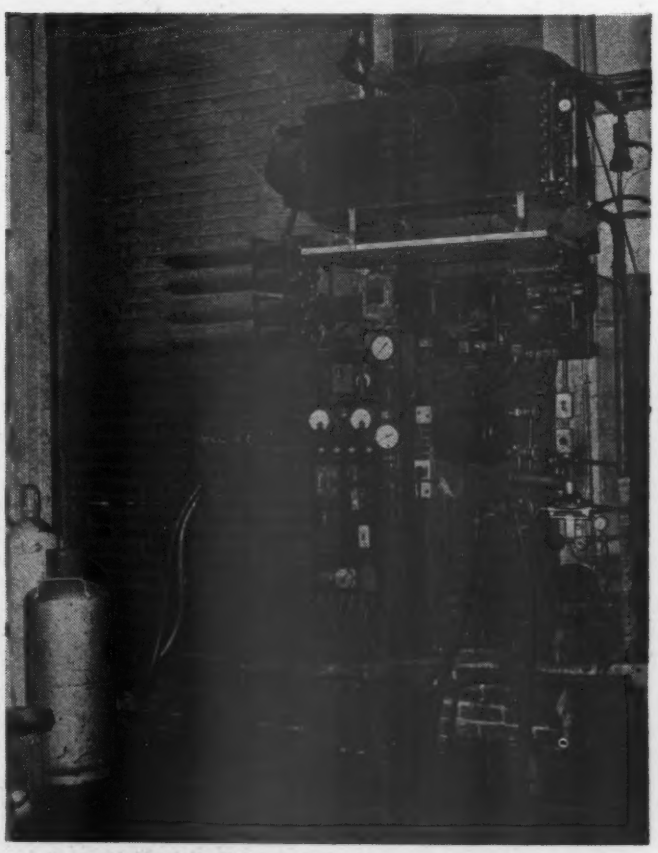


Fig. 2—Close-up of both the ice engine and engine generator unit

Fig. 3—One of the benches for overhauling parts

a lock nut is loosened. Figure 4 shows a portable holder for engine crank cases in use at Southern Pacific's Sacramento shops. Figure 5 indicates a test rack for checking and adjusting ensign regulators, solenoid refrigerant valves, and combination oil pressure and water temperature switches. Figure 6 shows a starting motor armature being rewound.

Engine cylinders are rebored to .020 in. and .040 in. oversize when wear limits as recommended by the Waukesha Motor Company are exceeded. No re-sleeving has been done as yet.

A number of worn crank shafts have had bearing surfaces built up to standard sizes with fair results. Recently chrome plating has been tried out and thus far this method of repairing appears to be highly satisfactory.

When a unit has been overhauled and tested, a metal tag is placed on the control box door indicating the date and place where the work was done.

The same general procedure is followed in the overhauling of engine-generator units. In addition to the engine, the generator is completely torn down and rebuilt. It is usually necessary to replace drive bushings.

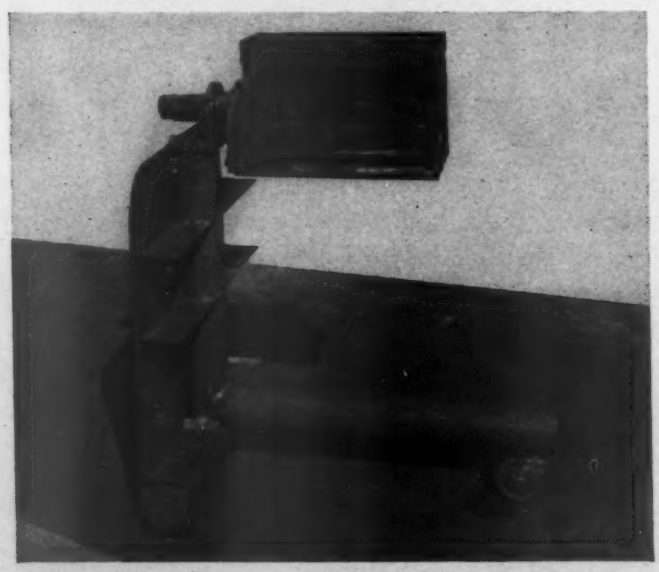


Fig. 4—Jig for holding Waukesha engine cylinders when repairing and assembling

Brushes are checked for neutral point and set as required by use of a dummy brush under full load. As in the case of ice engine units, engine-generator units are also tested under full load conditions before being released for service.

The Waukesha units are moved to and from shops to cars by use of either portable dollies, so constructed with tracks that units can be rolled on or off tracks or the cars, or by the use of finger lift tractors. Where platform heights are uniform, the doll are quite satisfactory.

Maintenance schedules are arranged progressively the year around rather than for any particular period due, first, to all-year cooling service on most of the first rate trains and, secondly, a regular maintenance force can be set up with experienced men, thus reducing to a minimum the poor quality of workmanship inherent with ever changing personnel.

Testing Equipment and Procedure

The test equipment for the ice engine unit consists of parts similarly used in the car, that is, an evaporator with the usual expansion valve, solenoid refrigerant valve, piping, receiver tank, etc. The same conditions are set up on the test equipment as are found on an air conditioned car.

Likewise, for the engine-generator unit, resistance grids with a rheostat are used so that any load, from no load to full load, can be placed on the generator.

Following is a general outline of the test procedure for each part tested:

ICE ENGINE UNIT

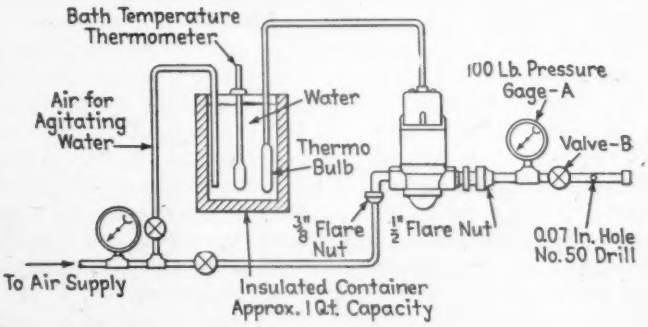
1. Apply 5 quarts grade SAE-10 break-in-oil.
2. Connect up all cables and piping and start engine.
3. Check timing with timing gun and adjust modulator to obtain proper speed at no load (1,150 to 1,200 r. p. m. for model C and D units).
4. Observe oil pressure and adjust to 30 lb.
5. Take compression reading of each cylinder, with spark plugs removed. Compression should be about 115 to 120 lb. per sq. in.
6. Check vacuum (should be 15 in.) and operation of vacuum switch.
7. Evacuate system and check for large leaks.
8. Apply 4 lb. freon and pump up to 250 lb. head pressure, then equalize. Check with halide torch for small leaks.

Right: Fig. 5—Test rack for checking and adjusting ensign regulators—Below: Fig. 6—A starting motor being rewound

9. After all leaks are repaired evacuate again.
10. Apply full charge of freon.
11. Again test for leaks with halide torch.
12. Check operation of high and low pressure switches.
13. Run equipment for 8 hours.
14. Remove break-in-oil and apply standard grade SAE-30 motor oil.
15. Again check oil pressure and adjust if necessary.

ENGINE GENERATOR UNIT

1. Apply 5 quarts grade SAE-10 break-in-oil.
2. Connect up all cables and piping and start engine.
3. Check timing with timing gun and adjust modulator to obtain proper speed at no load (about 1,400 r. p. m. for model B units).
4. Observe oil pressure and adjust to 30 lb.
5. Take compression reading of each cylinder with spark plugs removed. Compression should be about 125 to 130 lb. per sq. in.



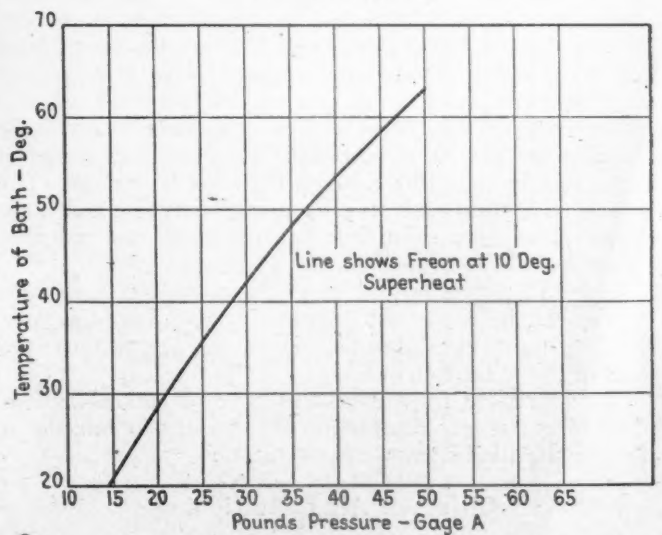
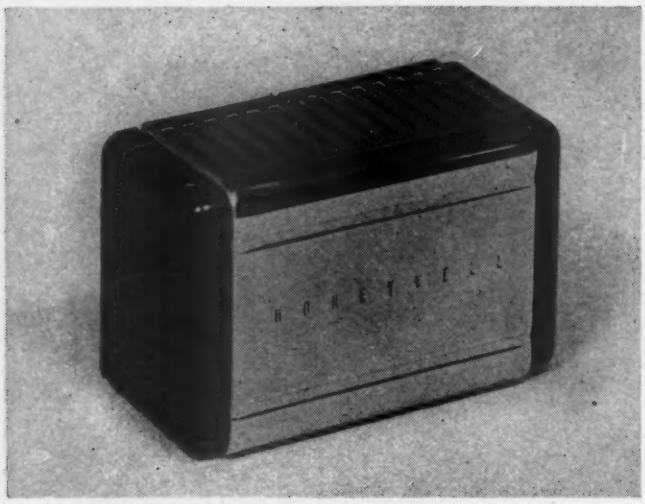


Fig. 7—Air conditioning expansion valve test rack

6. Check vacuum (should be 15 in.), and operation of vacuum switches.
7. Check brushes on generator commutator for neutral point by use of low reading ammeter and dummy brush.

(Continued on page 34)

Electronic Air Conditioning Control



Thermostat for wall mounting

Chesapeake & Ohio will equip 284 new cars with heating and cooling controls developed by the Minneapolis-Honeywell Regulator Company

THE Chesapeake & Ohio will make the first railroad application of a new electronic type of air conditioning control recently produced by the Minneapolis-Honeywell Regulator Company, Minneapolis, Minn. In the place of thermostats with moving parts, the system employs a control which consists of a Wheatstone bridge, one leg of which is placed at the point from which temperature control is to be affected. Change of a small fraction of a degree will upset the delicate electrical balance of the bridge, and this unbalance is amplified electronically to operate the control valve or valves. A number of such controls are placed at strategic points inside and outside the car and serve almost to anticipate the need for changes in the amount of heating or cooling required.

Another feature of the system is the use of a heat exchanger from which heat is transferred to a non-freezing liquid which is pumped through the finned-tube radiators which supply sidewall heat. This arrangement distributes the heat evenly to each seat in a coach or each room in a sleeper. This makes it possible to have the heating surface at a temperature which just compensates for the heat loss through the shell of the car. The overhead heating controls are made to dominate and there is never any confusion between overhead and sidewall controls.

Sidewall panels spaced away from the inside surface of the car, behind which heated air rises from the floor heating units eliminate the chilly surface against the arm of the passenger in the window seat.

To appreciate fully what this type of control system does for passenger comfort, it is necessary to consider a few of the fundamental requirements.

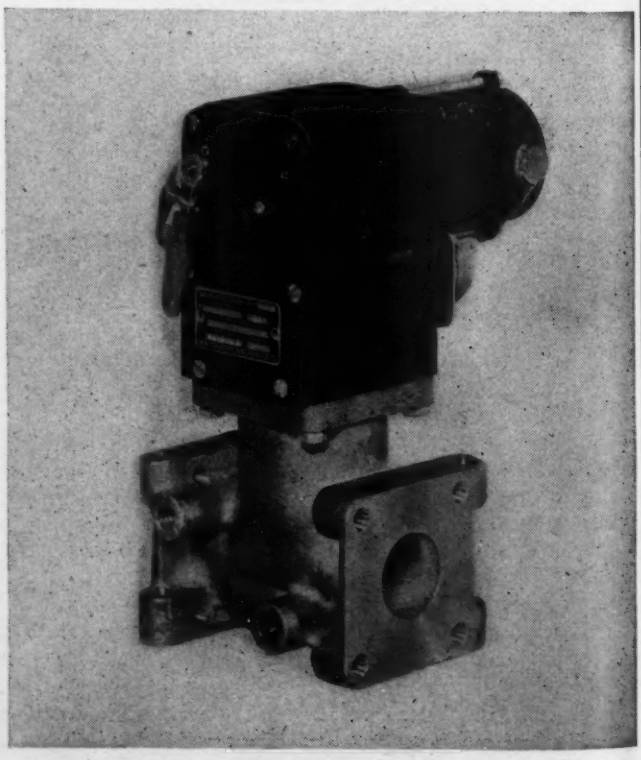
Object of Air Conditioning

The human body has its own heating system and its own temperature control. The problem is to make it possible for the human body to dissipate its excess heat at a rate which involves the least effort and provides the greatest comfort.

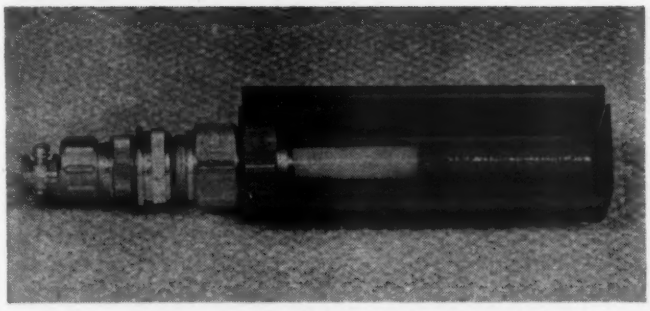
Body heat is lost through radiation, convection, evaporation, and respiration. The body radiates heat to surrounding walls, windows, and other objects which are at a lower temperature. The body gives up heat to the surrounding air by convection when the air is cooler than the body surface temperature. Moisture is constantly evaporating from the body surfaces which provides for cooling, and air taken into the lungs at normal temperatures is exhaled at higher temperatures, thereby removing a certain amount of heat.

There is a narrow range of atmospheric conditions in which comfort is sensed, and any changes in atmospheric condition, which requires a change in the rate of heat loss, or a change in the manner in which heat is lost, causes a certain amount of discomfort.

Conditions affecting comfort which may vary within a car are air temperature, air movement, relative humidity, and the temperature of the walls, windows, and other objects. If any of these conditions change, the body must adapt itself to the new conditions by a change in the rate or manner of losing heat, thereby establishing a new balance. The air conditioning system should establish the proper space conditions to maintain at all times maximum bodily comfort.



Electronic modulating valve—Motor which has 140 positions and sealed life lubricated gear train is shown at top—The valve body is packless



"Skin thermostat" for surface mounting

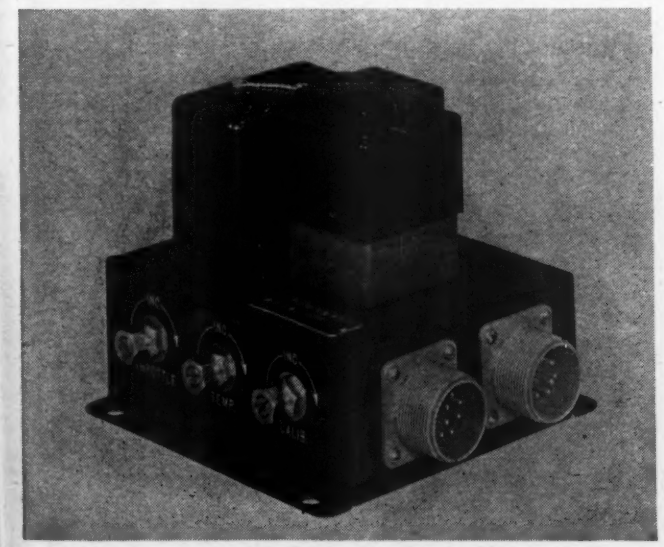
In addition, the temperature throughout the space should be as nearly uniform as possible so that there will be a minimum temperature difference between floor and ceiling. Frequently cold floors and sidewalls permit uncomfortable conditions to prevail even though the space thermostat is satisfied. To correct this condition, a continuous flow of heat or cooling should be maintained which will produce a constant circulation of conditioned air in the passenger car.

"Moduflow"

"Moduflow" is a new word which the manufacturer has coined to stand for modulated heat or cooling with continuous flow of the heat medium (air, water, steam, electricity).

Modulated control disposes of "on and off", or intermittent heat supply, and is made to meet the increasingly exacting demands of car air conditioning.

Heat loss from a car is continuous, but the rate of loss varies with the weather, train speed, tunnels, etc. Therefore, the heat supply should also be continuous and modulated to whatever rate is required to exactly offset the heat loss, thus maintaining a continuous balance between heat loss and heat supply.

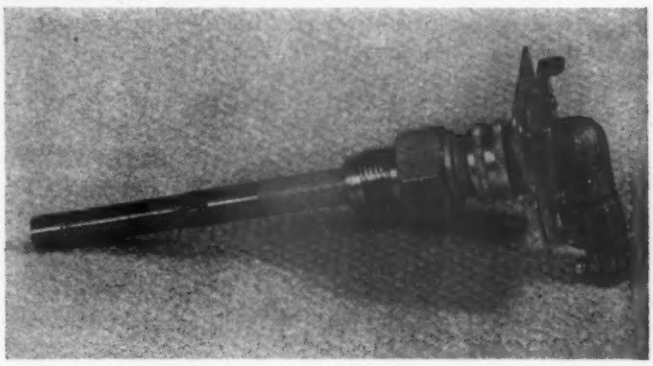


Bridge and relay unit

System Requirements

The following basic fundamentals determined by test indicate certain system design and control deficiencies which make it difficult to provide the hourly, daily and year round comfort requirements of all the various operating conditions. This is evident from the following:

(1) Car or individual room temperatures are dictated by the overhead air system. Therefore, in order to compensate immediately for internal changes caused by opening end doors, sun versus no-sun effect through windows, change in internal passenger load, etc., it follows that in order to properly rebalance space temperature immediately, the delivered air temperature must be constant for any one set of outside and inside conditions



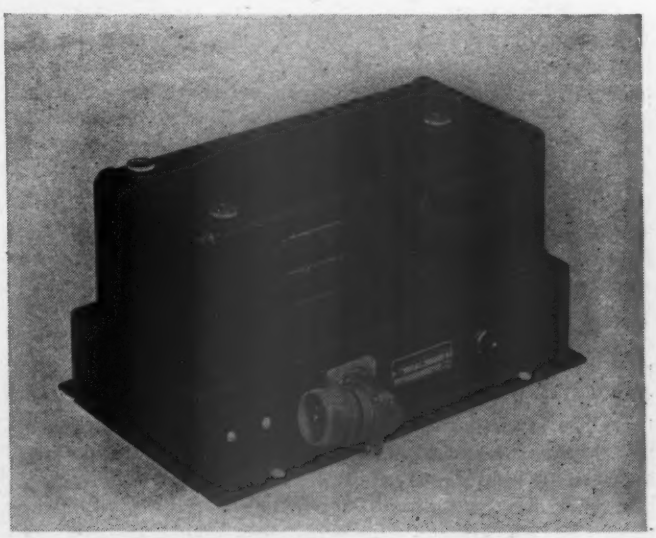
Thermostat for duct mounting with mechanical "snap-on" to duct and quick electrical disconnect A-N connector

and must also have variable discharge temperature characteristics under control of an accurate modulating valve, directly controlled through a sensitive, responsive car thermostat.

(2) The overhead air system and floor heat must work as a team, and the floor heat surface must provide satisfactory compensation for variation in heat transfer (radiant or conducted) through opposite sides of a car. This is true for either the cooling or heating season.

To fulfill all of these requirements, the Minneapolis-Honeywell control system employs side-wall heating which consists of a radiant panel incorporating a finned surface filled with a newly developed liquid solution (Tetracresylsilicate) circulated in a closed system principle. During normal operation the liquid temperature will be varied under control of a modulating valve and skin temperature thermostat adjacent to the outside covering of the car so that the radiant panel temperature will be maintained at such a temperature as to eliminate the cold side wall effect to the passenger. Separate control will be provided for each side of the car to compensate for sun versus no-sun, etc.

(3) Since humidity conditions play an important part in passenger comfort some humidity limit or control



Amplifier—Serves up to nine individual bridges when desired in multiple zone cars

should be maintained depending on climatic conditions under which the cars usually operate. The method of two-staging the cooling coils under control of a dry bulb thermostat will not always take care of many intermediate spring-fall days, since every "off" cycle of the compressor permits a rise of internal humidity and often times causes frequent machine short cycling. To establish definite maximum humidity limits for passenger comfort under most of these conditions, the cooling system is operated under full or half capacity to effect constant moisture removal and the air reheated to provide a satisfactory space temperature. Since this method requires accurate and continuous control of overhead air temperature, this new system inherently adapts itself to positive humidity control.

(4) Whereas conditions in coach, diner, lounge and open space cars must be regulated at a point satisfactory for the group, the problem differs considerably if the objective desired is individual or personalized temperature selection in room type sleeper cars.

Individuals in their own home will put up with a lot of unsatisfactory performance if the system is one which they have personally decided was the "best" equipment to buy. This is contrary, however, to the average railroad passenger who reasons, "This railroad has been advertising its marvelous air conditioning system, and now I want to retire and though I twist this knob as much as I can, I still can't change this room temperature to the level I am accustomed to for sleeping."

The present room car heating is affected by admitting more or less steam to the floor heat surface. Since the overhead air supply dominates in room temperature, it then appears that means must be provided for actually varying the delivery air temperature to each individual space if personalized room control is to be had.

One way this can be accomplished is by installing small individual booster heater coils in the supply air duct to each room. Liquid is supplied to each booster unit from the same heat exchanger source supplying the two side wall radiant panels. The new room control system will consist of a manual control point selector, resetting an electronic room thermostat which in turn accurately modulates the flow of liquid to the booster and provides constant room temperature at the desired level. This system provides a definite means of humidity control through the reheat method and also definitely compensates for the present overheating of rooms which are continuously subject to sun effect.

(5) Change-over from heating to cooling and vice versa cannot satisfactorily be done manually. The average human being cannot sense the right moment. This is especially true of the train crew or porter because they are active in contrast to the passengers at rest. Secondly, this moment of correct change-over may occur scores of times a day, which is certainly asking the impossible of the train crew. Automatic change-over is automatically accomplished in the new electronic system to avoid first, heating overshoot, then cooling undershoot, since the same car thermostat is used for heating and cooling.

The electronic temperature control consists basically of a Wheatstone Bridge with one leg used as a resistance thermostat. Changes in temperature around the thermostat cause the coil of wire to vary its resistance and thereby unbalance the electronic bridge. In this way, an unbalance of the bridge in one way will call for cooling, and an unbalance in another way will call for heating, giving automatic change-over which can be made practically instantaneous.

Electronic means are used to amplify the unbalance of the bridge sufficiently to cause a polarized relay to operate a reversible motor connected to a valve, damper motor or step controller. This makes it possible for the valve to assume any one of 140 positions to exactly meter the right amount of steam or liquid required.

The use of a coil of wire as a thermostat introduces one of the revolutionary changes in railway car temperature control and the bridge principle provides complete flexibility for any combination of controls or sequence required. Very little mass surrounds the coil of wire which is the themostat, and this coil of wire is sensitive to about one-tenth of a degree Fahrenheit, providing extremely fast reaction.

Maintaining Waukesha Equipment

(*Continued from page 31*)

8. Apply full load to generator (175 to 180 amp.) and again check speed (should be 1,125 to 1,150 r. p. m.).

9. Run equipment for 8 hours.

10. Remove break-in-oil and apply standard grade SAE-30 motor oil.

The fuel regulator test stand as shown is furnished by the manufacturers of the regulator, Ensign Carburetor Company, Ltd., Los Angeles, Calif. A complete set of instructions accompany this piece of equipment and this test procedure is followed religiously on each fuel regulator.

Many main and pilot valves can be reclaimed by refacing on a special machine.

The solenoid refrigerant valve is disassembled, all worn parts renewed or repaired, and strainers cleaned. After reassembling, the valve is connected to the air line and the coil to 32 volts d. c. By pressing a button the operation of the valve is checked. A pilot light indicates if the coil is energized.

The sketch shows how expansion valves are tested.

Air supply pressure must be at least 80 lb. per sq. in.

Temperature of water should be 40 to 50 deg. F.

Allow a small amount of air to flow into the water for agitation to maintain uniform temperature.

Place expansion valve control feeler bulb in water and close discharge valve "B." If pressure shown on gauge "A" increases to 25 lb. or more within 3 minutes, excessive regulating valve leakage is indicated and complete expansion valve should be replaced.

Open discharge valve "B" allowing air to escape through the .07 in. orifice in pipe and read pressure as shown on gauge "A," and check with chart on drawing.

If valve does not regulate at a pressure within one pound of that shown on chart, it must be readjusted.

Combination Oil Pressure and Water Temperature Switch

TEMPERATURE ELEMENT

1. Place thermal element in oil bath and agitate.

2. Note temperature when pilot light, connected through switch contacts goes on. This should be approximately 225 to 230 deg. F.

3. As the oil temperature decreases the switch should open its contacts at 10 deg. to 15 deg. below the closing point. An adjusting screw on the side of the thermal power element is turned to make proper adjustments.

PRESSURE ELEMENT

1. By use of air and a gauge, oil pressure adjusting screw can be varied to make the switch contacts break at 8 to 10 lb. on increase.

2. Adjust to 4 to 5 lb. on decrease.

Diesel Locomotive Design for

Lower Electrical Maintenance*

By W. C. Marshall†

Railroad users suggest that the builders simplify design and make parts of different locomotives interchangeable

MANY of the railroads in this country have been, and are at the present time, acquiring Diesel locomotives from most, if not all, of the Diesel locomotive manufacturers. These locomotives are of various types, including several sizes of yard, switch, road switch, freight and passenger. Each manufacturer is, from year to year, making improvements on his product; in many cases developing new parts that cannot be applied to the locomotives which were offered the railroads in previous years. The locomotive of today compared to the locomotive of ten years ago is proof of the progress that has been made by these individual manufacturers and has resulted in the surprising increase in the number of locomotives acquired and put in operation.

There is a problem increasing on each railroad with the same speed as the new Diesel power is acquired;—how are all of these increasing numbers of different makes and different types going to be maintained? The manufacturers, due to the highly competitive market and the desire to equal, if not lead, the field and still meet competitive cost, have made their own individual standards much the same as practiced in the automobile industry. They have not, up to this time, coordinated as a group to standardize on any parts on the locomotives except where it has met their own convenience.

Standardization of equipment, wherever possible, will bring about as much economy in maintenance as anything else that can be done. At present, the railroads are facing the ever increasing demand to enlarge their stock of different parts and protection equipment which perform the same function on locomotives bought from different manufacturers as well as parts or equipment purchased from the same manufacturer for models of different years.

There are scarcely any railroads in the position to manufacture replace-parts, and they are required to stock an ever increasing number of new items as well as keep the stock shelves well filled. Along with this comes the problem of training store department forces and engine crews.

Improvement in design as well as the improved method of locating equipment on the locomotive go hand in hand with the standardization of equipment in helping to bring about economical maintenance.

Control Wiring

The control wiring on a Diesel locomotive is too often the cause of delays in dispatching locomotives from the maintenance point on time. The tagging of all control wires and cable to conform with the wiring diagrams should, of course, be continued by those manufacturers who do so, and put in practice by those who now omit tagging a portion of the wires.

All wiring and conduit should be located in the locomotive as accessible as possible for repairing or renewing the wiring and the conduit. Where there are a number of wires in any conduit or cable, there should be a minimum of one extra wire for every six wires. Some manufacturers are starting to substitute indicating circuit breakers instead of fuses in control circuits and other low voltage circuits. This is a step in the right direction. Indicating circuit breakers would be a big help at a maintenance point in locating trouble quickly and most valuable on the road in reducing delays where the engine crew is not too familiar with the locomotive. The possibility of improper circuit protection would be eliminated where the application of a wrong capacity fuse by inexperienced or careless employees often times results in damage to the electrical equipment.

Electrical Relays and Contactors

All relays, contactors, switches, circuit breakers and fuses should be plainly stencilled so any of them can be readily identified by men not too familiar with that type of a locomotive. Considerable improvement can be made in locating some of the cam switches, relays and control panel apparatus to make them more accessible for inspection and maintenance. The best inspection and maintenance is always made on the equipment that is the most accessible.

The 74-volt control system seems to be adequate. It is highly important, however, where operating a control system of that voltage, that the contact points of relays and interlocks be of good material and the contact points have some wipe at the time contact is made. There can be considerable improvement made in this regard on the majority of Diesel locomotives now in use.

Traction Motors

The majority of the larger railroads today are either doing most of their own traction motor repair work or are contemplating doing it in the near future. The number of types of traction motors necessary to protect the operation as well as the stock of windings and other materials used in the repairing of these motors, could be cut down to a large extent if the manufacturers were to agree on a common design. This is a rather delicate subject with the manufacturers, but the already large and ever increasing number of motors not interchangeable on the different sizes and makes of locomotives, certainly isn't a very bright outlook for the future.

The ideal situation, from a maintenance angle, would, of course, be one common traction motor for all Diesel locomotives. If this scheme were found unworkable, the use of one traction motor design by each manufacturer for all their different types of locomotives, would help the present situation. One manufacturer now is employing one design for all of his traction motor requirements with the exception of adding a cooling fan mounted on the armature shaft on his 600 hp. locomotive. Another solu-

*Abstract of a paper presented before the Railroad Division of the American Society of Mechanical Engineers, New York, N. Y., December 4, 1946.

†Assistant Superintendent Motive Power, Chicago, Milwaukee, St. Paul & Pacific Railroad Co.

tion would be the standardization of the design of traction motors for locomotives of similar horsepower.

Batteries

One item I am sure that could be worked out by the different manufacturers is the standardizing of the battery compartment size for this would help in reducing the number of battery sizes which the railroads are required to stock.

The ventilation of the battery box compartment, the head room above the battery cells, and the drainage of the compartment are of vital importance. There should be sufficient screened openings in the compartment to insure proper ventilation. There should be at least eight inches of head room between the cell connectors and the ceiling of the compartment so that inspection can be made of the battery connections and water added to the battery cells conveniently. There should be sufficient opening in the compartment floor so that it would drain easily.

There seems to be a tendency of most manufacturers to standardize on 64-volt auxiliary power. Where lead storage batteries are used, the 32 cells, arranged in 4-cell trays, seem to offer the most logical answer. This would make it possible to standardize on intertray connector cables. I am sure batteries other than the lead type can be so assembled to conform to the physical size limits set for lead batteries.

I recommend that the number of battery sizes now used on Diesel locomotives be reduced to three or less, namely: 280 amp.-hr capacity (8-hour discharge rate); 420 amp.-hr.; and 490 amp.-hr.; these ratings being approximate.

The 280-amp.-hr. battery may be considered to have more capacity than necessary for the 600 hp. switching locomotive. However, I believe that the larger type battery can be expected to give longer life and allow the railroad to carry fewer sizes of batteries in stock. This would offset the difference in the first cost between the two sizes to a great extent. To the best of my knowledge, the 490 amp.-hr. battery is of sufficient capacity to take care of the larger locomotives manufactured up to this time. There is a definite possibility that the 420 amp.-hr. battery will be sufficient to meet the requirements on the 2,000-hp. Diesel engine. If this proves true, it will only necessitate carrying in stock two battery sizes; the 280 and the 420.

The storage batteries, while rated at the 8-hour discharge, should have a high voltage characteristic during high discharge rates. These should be at least 1½ in. of operating range of the electrolyte level. Many of the switcher type as well as the road switcher locomotives are expected to stay away from the maintenance shop between monthly tests so it is most important to have sufficient range of electrolyte level to insure safe battery operation during that period.

Lubrication

The lubrication of electrical equipment is a very difficult problem due to the inaccessibility of the bearings for inspection and maintenance. I refer mainly to the traction motor armature bearings and the end main generator bearings. Up to very recently, practically all of the end generator bearings and traction motor armature bearings have been grease lubricated; grease being used due to the difficulty of keeping oil in the bearing housings.

Grease is a mixture of petroleum oil and soap, and is generally only used where oil cannot be maintained in the bearing long enought to provide adequate lubrication. The soap binder retains the oil lubricant and has rather poor lubricating qualities in itself. Under severe service conditions, the grease separates and the oil flows away leaving the soap binder which clogs up grease line fittings, or the clearance spacing of the bearings. As grease is periodically added to the bearing, it is difficult for the lubricating film of the grease to reach the parts to be lubricated. Over a period of time, hard soap builds up in the bearings resulting in the bearing failure unless it is periodically opened up, cleaned out and new grease applied.

The petroleum companies have made considerable progress in developing greases which do not separate easily but these greases at best are not too good a substitute for lubricating oil. Recently one Diesel manufacturer has been turning out oil lubricated roller bearings with apparently good success. I feel certain that a bearing and housing can be developed in which oil can be used as a lubricant. In so doing, the height of the oil in the bearing housing can be checked frequently and the oil can be drained and flushed periodically, and new oil applied. This should result in the longer life of the bearing itself.

I have made a number of recommendations which I know will be difficult for the manufacturers to accomplish but I am certain in my own mind that considerable improvements can be made along the lines I have discussed and satsified that the resulting decrease in the cost of maintenance and, for that matter, operation of the Diesel locomotives themselves, will be effected.

Discussion

The following is an abstract of discussion prepared by J. W. Teker, Transportation Motor Engineering Division, General Electric Company, Erie, Pa., which was presented by T. F. Perkinson, assistant manager of the Division.

The presentation of the accumulated experiences of men whose daily concern is the operation and maintenance of Diesel-electric locomotives is most valuable and stimulating to the manufacturers. The impact of such experience, when integrated, becomes a powerful factor for influencing designs.

It is now apparent that in the space of only a few years the emphasis has shifted from custom-built locomotives, when each railroad demanded special features for their requirements, and were reluctant to accept designs used on other railroads, to a concern for standardization to expedite the growing problem of maintenance as more motive power is acquired.

The present situation is one result of the Diesel-electric locomotive's rapid development. It has been so swift that the earliest designs cannot, as yet, be considered obsolete. The maintenance problem is, therefore, accentuated by the contrast of parts between the diversity of designs and is most acute on railroads which have done most to foster the development of this motive power.

While at first glance this diversity may appear deliberately chaotic, the orderly analysis of the types will show natural modification as locomotive builders and operators worked together to evolve types suitable to the changing demands.

The earliest designs, for example, provided electrical drive for all auxiliary functions, the power being supplied from a large direct-current auxiliary generator driven at engine speed and regulated for a constant battery voltage. This system provided motor-driven traction-motor blowers, radiator-cooling fans, and air compressor all independent of engine speed and operated only when required. This type, still in operation today, has an enviable record for flexibility, reliability and low auxiliary maintenance, but the cost and weight ratio based on available power for traction was thought to be excessive.

The endeavor for lower costs and weight with more

power for traction led to the employment of direct- and belt-driven systems for auxiliaries. However, as we have learned through operating experience, this simplified system, while effective in its first objective, lacks the reliability and flexibility of the all-electric system unless given frequent and continued maintenance attention.

This unfavorable factor alone has influenced design trends again in the direction of a modified electrically-driven system for traction-motor blowers and radiator-cooling fans to lower the high maintenance costs resulting from failures and upkeep of the belt-driven counterparts. But here again the mechanically-driven air compressor is retained, for even though design considerations recognize electrical drive for compressors as ideal, it still cannot justify the weight and cost of the additional electrical apparatus required in the face of the demonstrated operating experience with the engine-driven system. Thus another stage in the evolution of this motive power is initiated through the evaluation of operating experience.

Development of electrical equipment for Diesel locomotives is inseparably associated with the growth of the engine. When one engine is developed to do the work of two, as in some of the most recent 2,000-hp. units, and permits a locomotive design in less space and weight with fewer parts, it inherently offers to reduce the largest single item of locomotive maintenance expense, a feature extremely desirable to any railroad. This, however, also called for a new generator design to match the speed and power of the new engine.

While it has been found possible within limits to increase engine power with the same basic parts by supercharging, increasing speed, or adding more cylinders, there is no similar expedient for modification of generators.

Likewise, the increased electrical output and new generator characteristics call for complete revision of the control and locomotive wiring.

Where a traction motor used with early low-power engines could ventilate itself, it soon was necessary to force more and more cooling air through it with blowers to keep pace with the increase in power. These blowers in turn influenced the auxiliary makeup of the locomotive.

To fully utilize the possibilities of a 2,000-hp. unit and retain the conventional truck of proven riding qualities, a new motor of increased capacity is necessary. To persistently increase the duty on electrical machinery leads ultimately to loss of margin and increased frequency of breakdown and high maintenance.

To freeze the design of any one item seriously handicaps the development of the whole locomotive. It is evident from the constructive suggestions offered by the railroad operators for the builders' consideration that improvement is still necessary. Admittedly, the builders of earliest designs, without the guidance of experience in a new field, were more concerned with making the Diesel locomotive possible than in standardization of parts and in this endeavor they were remarkably successful as attested by obsolete designs still doing a good day's work.

We are today, as manufacturers of this equipment, keenly aware of the service and maintenance problem and are actively engaged in programs where its importance is a major consideration.

As far as we are able, within our limitations, standardization has already influenced our latest designs.

A basic approach, for the present without arresting development, is to capitalize on one favorable factor in the constitution of electrical machinery. Aside from accidental or abusive damage, the major elements such as windings, commutators, shafts, cores and frame parts, when properly designed and manufactured, have demonstrated a dependable service life in terms of years with only routine maintenance. Therefore, wherever necessary to meet increasing demands these elements may be modified provided that as many expendable items such as brushes, brush holders, roller bearings, axle linings, and gearing are retained and used over as much as possible to simplify the stores problem and speed service and routine maintenance.

Furthermore, wherever possible, auxiliary equipment is designed with margin and interchangeable features so that it may be applied over a range of locomotives. The size and location should allow for quick removal and replacement when necessary.

Specifically, the application of these principles to the design and manufacture of electrical equipment for the latest designs of 1,500-hp. and 2,000-hp. locomotives made by different locomotive manufacturers is so effectiive that only the major elements of the main traction generators are different, the expendable items are alike and interchangeable. The traction motors, gearing, blower motors, auxiliary generators, amplidyne exciters, and in some cases, the radiator fans, radiator-fan drives, and electrical braking equipments, are identical and interchangeable. In most cases the pinion-end armature roller-bearing in the traction motor is identical and interchangeable with the main generator bearings.

This example represents the latest achievement in higher unit power, lighter weight, minimum parts, and yet a maximum of interchangeability of parts. Compared with over 100 years of steam motive power, the Diesel-electric locomotive, while still in its evolutionary stage, has already attained a degree of standardization which shows that we are well on our way towards this desirable objective.

The following is a summary of discussion presented by A. H. Candee, Transportation Engineer, Westinghouse Electric Corporation, Pittsburgh, Pa. Both the Westinghouse Electric Corporation and the General Electric Company have developed higher capacity and better motors, and it is our wish to profit by the suggestions from the railroad users. Standardization is desirable, but one manufacturer cannot standardize for another, and too much standardization may stifle development.

Westinghouse has standardized on two motors. Another manufacturer has standardized on one motor for all purposes, but it is our belief that that motor is too small for all locomotives. Westinghouse makes a 6-pole motor weighing 7,300 lb., while General Electric has a 4-pole motor weighing 9,000 lb. The situation raises a question of what kind of an agency can be created to cause manufacturers to get together.

Oil lubricated motor bearings are desirable and probably will eventually be used generally, but it is a small item. Much more can be saved by improvements in locomotive operation. There is a tendency to push Diesel locomotives to the limit of their capacity with resultant damage to electrical equipment. Overloading causes damage which does not show up immediately. If tonnages were cut 10 per cent, the locomotives would still make a good showing. Frequently steam pushers are not well matched or properly operated when used with Diesels.

In response to Mr. Candee's discussion, J. P. Morris, of the mechanical department, Atchison, Topeka & Santa Fe, said the Santa Fe does not have any short time rating on Diesels, that they are used only with full time rating. He also added that when steam helpers are used on grades up to 3½ per cent, the steam locomotive is allowed to do most of the work.

NEW DEVICES

Tennant Floor Cleaning Machine

A floor-machine attachment developed to clean heavy deposits of grime, grease and dirt from industrial floors has been adapted for use in railroad back shops and enginehouses with excellent results. The attachment is called the Revo-Tool and fits into the floor machine manufactured by the G. H. Tennant Company, Minneapolis, Minn. One of several attachments for various floor conditions, the tool was designed to remove efficiently difficult soilage from floors—grime that previously required tedious and expensive manual methods.

The Revo-Tool is power-driven in the Tennant floor machine and pulverizes soilage by means of 300 tool-steel cutters mounted in rows in a specially designed drum housing. Each cutter is mounted loosely on its shaft to give a powerful hammer-mill action when the Revo-Tool revolves. Each cutter has projecting teeth which cut the floor grime when the machine is guided across grease-covered enginehouse and back-shop floors.

In operation, the Revo-Tool delivers 10,000 impacts per second against floor soilage. This enables the tool to remove both the top layer of soft grease found in railroad shops as well as the tough undercrust of rock-hard, impacted grime that defines ordinary methods of removal. Heavy soilage is flung into a built-in dirt drawer in the machine which is easily emptied when full. Light dust particles are drawn into a vacuum bag attached to the handle.

During demonstration tests in an eastern railroad back shop, the Tennant floor machine is said to have sheared off accumulations ¾ to 1¼ in. in depth. The soilage was composed of a top layer of soft grease and a hardened undercoat of packed-down dirt, the heavy build-up typical of grease-pit areas. The tool removed approximately eight wheelbarrows full of grime from 750 sq. ft. of surface. Dirt removal was so rapid that the dirt hopper in the Tennant machine was withdrawn and a heavy canvas shield used instead to keep the soilage from being thrown on the operator's feet. The dirt was shoveled into wheelbarrows. In another instance, the cleaning of engine house pits, normally an 8-hr. job for three men, was done by the Tennant floor-cleaning machine in 30 min.

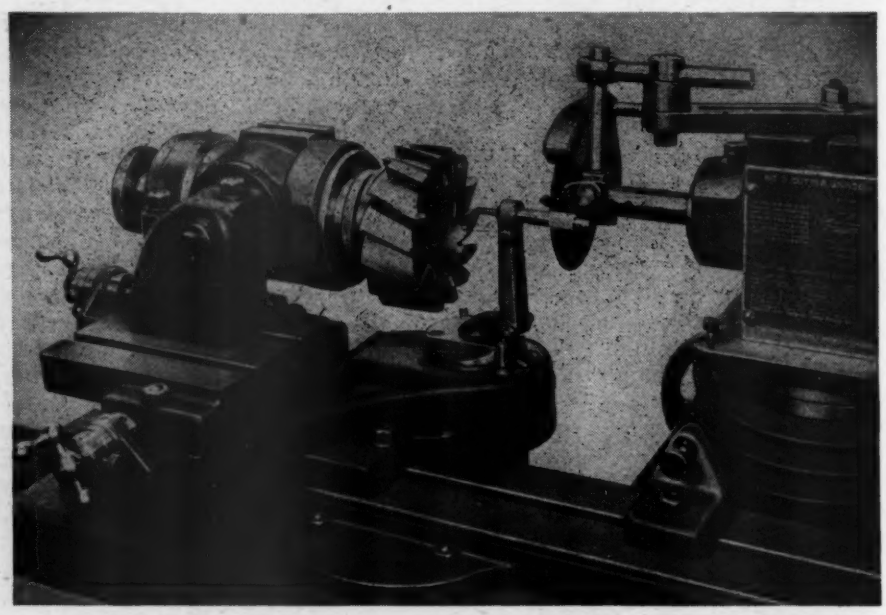
Tests with Revo-Tool cutters have led to the development of a number of types ranging from sharp to extremely blunt teeth.

The Tennant Model K floor machine and the Revo-Tool attachment at work on a typical enginehouse floor

Radius Grinding Attachment

The radius grinding attachment shown will grind an accurate radius up to 1 in. on cutters from 4 in. to 12 in in diameter having flute lengths to 3 in.

Adjustment to the desired radius is done through the micrometer gage, which has a range of 1 in. and pivots 90 deg. to positive stops. The cutter may be accurately offset through two adjustable stops to the desired radius as indicated by the direct-reading micrometer.



Adjusting radius grinding attachment with micrometer gage

The two slides carrying the cutter mounting assembly can be independently operated by crank and screw. Micrometer dials are fitted to the screws so that slides may be accurately moved in small increments. The complete upper part of the unit swivels on a large anti-friction trunnion, adjustable for wear. Adjustable positive stops are provided to limit the swing to 90 deg.

This device, known as the No. 2 Radius Grinding Attachment, is manufactured by the Cincinnati Milling Machine Company, Cincinnati 9, Ohio, for use on Cincinnati No. 2 Cutter and Tool Grinders.

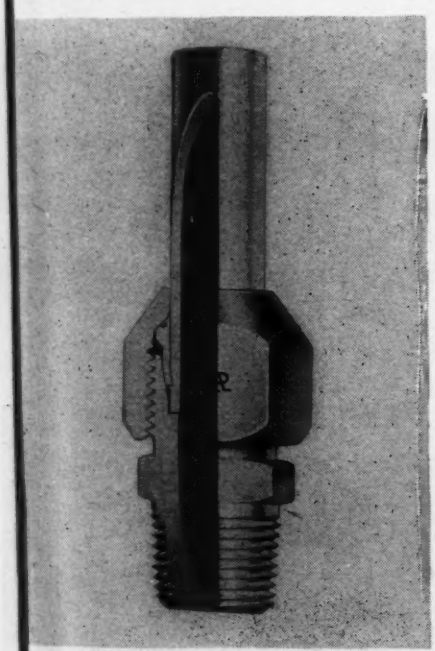
Flareless Fitting

A fitting for use in joining all types of metal tubing in hydraulic and fluid-conveying systems has been developed by the Parker Appliance Co., Cleveland, Ohio. Eliminating the need for special flaring and assembly tools, brazing or soldering, the fitting incorporates a steel ferrule which, when the body and enclosing nut are tightened up, acts to cut a shoulder in the tubing itself.

When the body and the nut are tightened,

the confined ferrule is forced forward. The cone angle of the body contacts the ferrule, and directs its sharp forward edge downward. The reduction of section in the leading edge of the ferrule permits deflection of the extremity so as to afford good camming contact for the bite into the tube. Further tightening at specified torques forces the ferrule into the tube, casting up a shoulder to resist pull-out when pressure is applied in the system. The actual fluid seal is also accomplished by the compression of the ferrule, which is said to have a negligible effect on the internal diameter of the tubing being fitted.

Meanwhile, a second grip has been generated at the rear of the ferrule for the dampening of possible vibration in the system, which would shorten the life of the front seal. The mismatch angles between the ferrule and the body which produce this secondary backgrip were designed for a positive, predetermined engagement, sufficient for dampening without kinking the tubing. The groove machined in the angular back surface permits this controlled action. The inner angle is first compressed and deflected inward to grasp the tubing,



Sectional view of the flareless fitting showing the action of the three fitting elements in a finished connection

while the outer surface acts as a stop to limit this effect. The compression of the ferrule also provides a lock-nut action in the assembly, an additional factor contributing to long service life of connections.

The three fitting units have a loose fit with the tube size to be used to promote ease of assembly and to permit the tube to center itself during make-up to facilitate a uniform depth of cut. The only tube preparations necessary are square cut-off and removal of burrs. Joints on which the new fitting is used may be broken at any time without affecting re-sealability, and any joint may be dis-assembled prior to final assembly for visual inspection of the quality of the gripping cut. These fittings are available for ¼-in. to 1-in. outside diameter tubes in conventional shapes and materials.

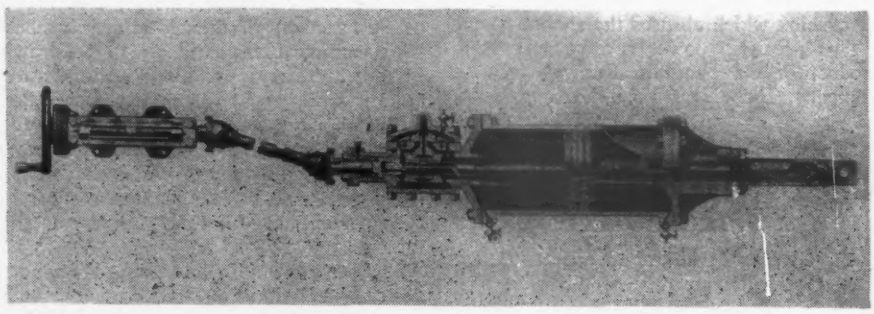
Self-Locking Power Reverse Gear

The Franklin Type F-3 precision power reverse gear features an automatic self-locking clutch to maintain the cut-off at the point set by the engineer. The clutch prevents unintentional movement of the hand wheel under the influence of forces transmitted back through the reverse gear.

The mechanism employed to attain this self-locking feature is a roller clutch containing six rollers, three of which act in each direction. These rollers lock by friction between the locking cam carried on the indicator shaft and the outer housing affixed to the indicator screw bracket. Any tendency to turn on the part of the locking cam is overcome by the wedge action which takes place due to the contour of the locking cam. This contour is such that movement of the locking cam, in attempting to drive the hand wheel, causes a reduction in the volume of space available for the roller to rest in. This reduction of volume results in the roller acting as a wedge and thereby stopping rotation of the hand wheel and subsequent change in the cutoff. The rollers are in locking position at all times except when the cut-off is being adjusted.

When adjustment is being made the appropriate set of rollers is moved by the three hand-wheel fingers to a position of larger area on the cam where they allow freedom of motion for rotating the cam. The adjustment made will be closely held by the automatic locking feature of the clutch; no manually operated latch is required.

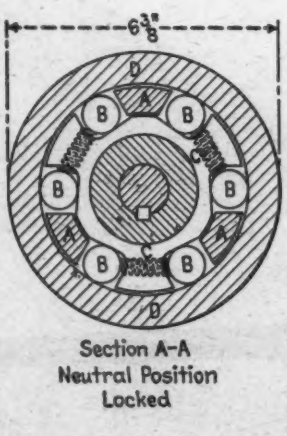
There are several design features which contribute to the accuracy and the maintenance of the setting. A one-to-one ratio exists between the reverse gear valve and the piston. Because of this smaller ratio



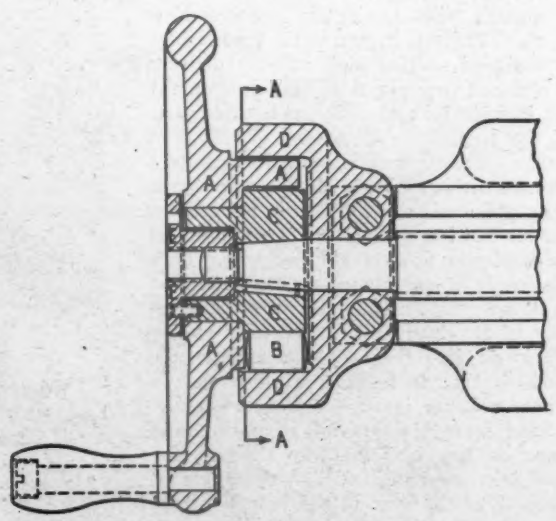
The Franklin Type F-3 reverse gear accurately sets and closely maintains the cut-off

Clockwise Rotation

Counter Clockwise Rotation



Section A-A
Neutral Position
Locked



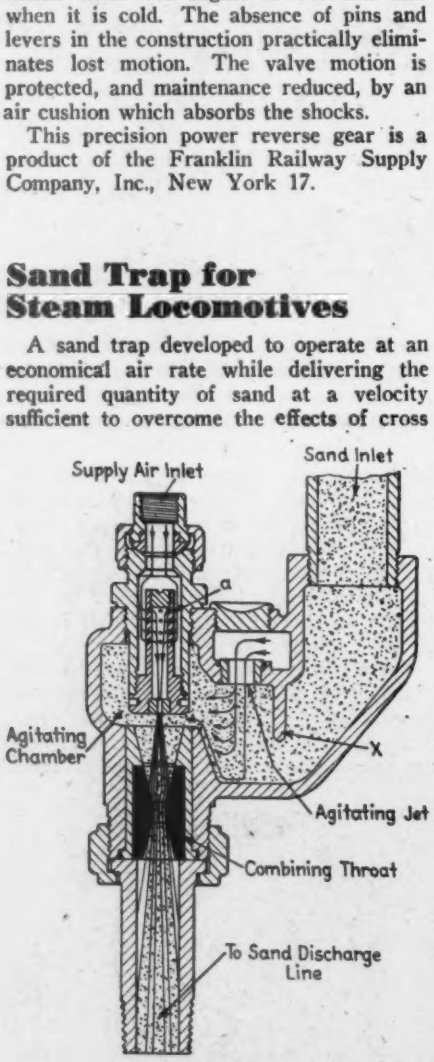
Cross-sectional views of the Franklin reverse gear showing how the rollers provide wedge action to lock the handle in place. Parts referred to by the symbols are: *A*, the hand wheel; *B*, the rollers and springs; *C*, the locking cam; *D*, the clutch housing; and *E*, the retaining nut

of movement the cut-off can be better maintained, and the locomotive performance increased. The rotary reach rod has slip joints to nullify the effect of expansion and contraction on the indication of the cut-off. No difference exists between the indication when the engine is hot and that when it is cold. The absence of pins and levers in the construction practically eliminates lost motion. The valve motion is protected, and maintenance reduced, by an air cushion which absorbs the shocks.

This precision power reverse gear is a product of the Franklin Railway Supply Company, Inc., New York 17.

Sand Trap for Steam Locomotives

A sand trap developed to operate at an economical air rate while delivering the required quantity of sand at a velocity sufficient to overcome the effects of cross winds or other turbulence around the wheels is available from the New York Air Brake Company, 420 Lexington avenue, New York. This trap, known as the type HS-96, is designed so that high velocity delivery is obtained with practically no wear on any but inexpensive and easily replaceable parts of the trap.



Type HS-96 Sand Trap

The ejector principle is used to create a vacuum within the trap. This vacuum causes atmospheric air to be drawn in to augment the air flowing through the sand pipe and to develop a flow of high velocity. Thus the supply of compressed air can be limited to flow through a small port for the economy of air consumption. Drawing atmospheric air into the trap also agitates the sand so that it feeds uniformly and in proper quantity into the outlet air stream.

Sand is fed by gravity from the sand dome or box into the trap through the sand inlet. Partition *X* and the angle of repose hold the sand at the bottom of the agitating chamber. During periods when the sanders are not in use, vibration can raise the level of the sand in the chamber without adversely affecting operation when the sanders are turned on.

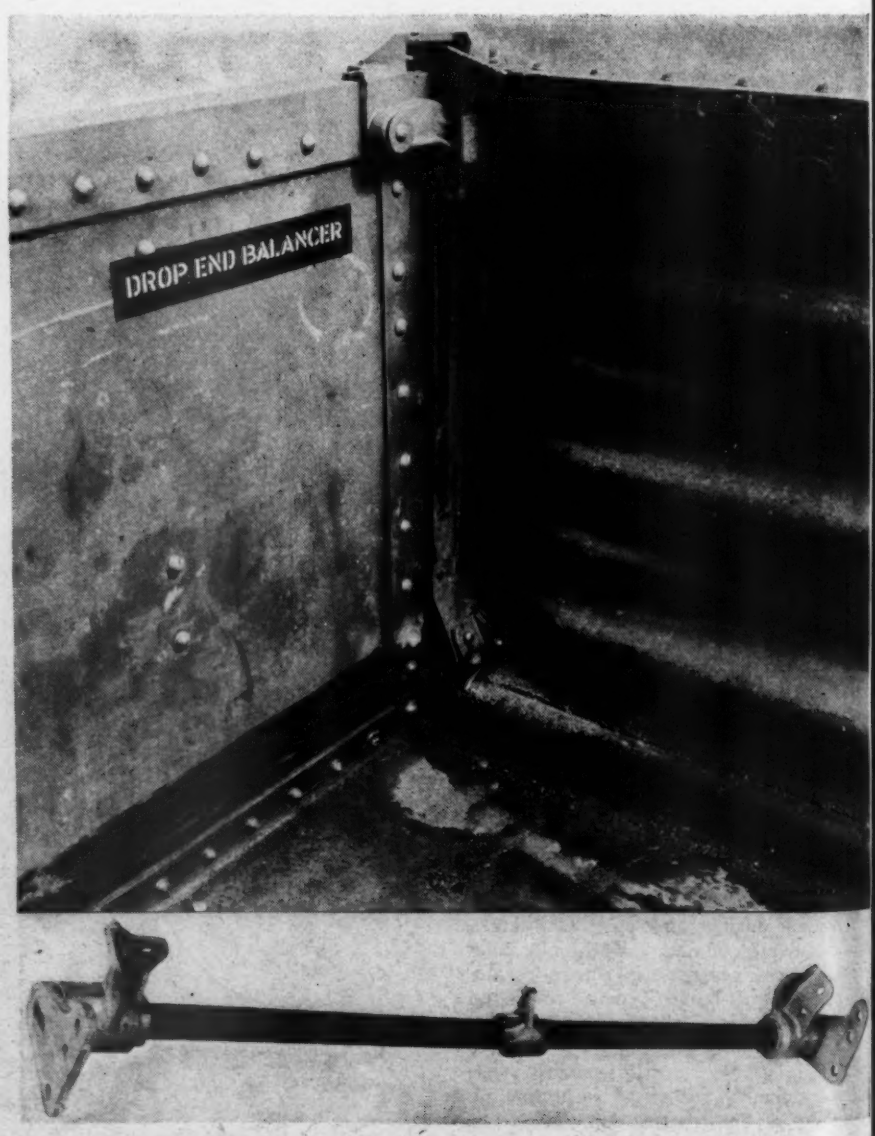
When the sanders are in use, air from the operating valve enters the supply air inlet and flows to the sanding jet through a multiplicity of annular drilled ports *a* which are of smaller size than the jet to prevent entrance of foreign substances which might plug it up. Air leaving the jet expands and gains velocity as it moves toward the combining throat, creating a partial vacuum in the agitating chamber. This causes atmospheric air to be drawn in from the atmospheric intake through the agitating jet. Sand is agitated and picked up from its repose position so that the agitating chamber is filled with sand-laden air which is drawn into the stream of air from the sanding jet and blown out into the sand discharge line for delivery to the rail.

The sand laden air does not attain a high velocity until it is on its way out of the trap through the wear-resisting rubber combining throat and a special union stud, both of which absorb the major part of the sand blasting effect. To regulate the rate of sand delivery the orifice bushing, or agitating jet, in the atmospheric intake passage at the point of entry to the agitating chamber can be varied in size. A conical rubber nozzle at the end of a sand discharge line directs the high-velocity flow of sand to the point of wheel-and-rail contact and provides an opening protected against plugging by ice.

Drop End Balancer

To enable one man to close the heaviest drop ends without the use of special tools, the Wine Railway Appliance Company, Toledo 9, Ohio, has developed a drop end balancer for installation on any type of gondola car.

Torsion bars located within a heavy enclosure on the bottom of the drop end make easy lifting possible. The bars are anchored to the center of the drop end by a casting, and extend outward to both sides through the enclosure and hinge castings. Hinged trunnions riveted to the car body anchor the torsion bars on the outer ends. As the drop end is lowered, the torsion bar anchor



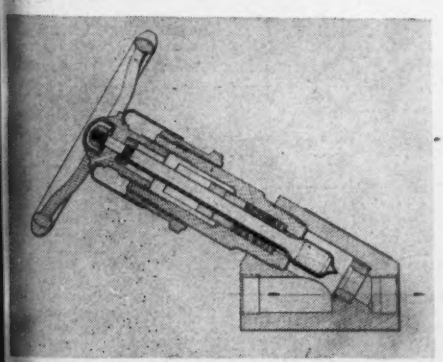
Top: The drop end on a gondola car equipped with the Wine Drop End Balancer—Bottom: Torsion bars showing center casting, hinge castings, and trunnion castings

in the center turns the inner part of the torsion bars while the outer ends are held stationary. When the drop end reaches a horizontal position the torsion bars are at maximum load and thereby lessen the initial effort required to raise the drop end. In the closed position, there is enough tension remaining in the bars to retain the drop end in its vertical position, thus eliminating danger of the end dropping accidentally on the operator while the drop end is being secured.

The enclosure within which the torsion bars are contained is adaptable to any design of drop end; the bottom portion of the old end is removed and the new enclosure welded in place. This enclosure replaces the lower flange of the present drop end and protects the bars from the lading and the weather. It is made with a round bottom so that any accumulation of foreign matter will not interfere with the proper operation of the drop end. The round bottom prevents lever action and the subsequent difficulty in securing the locks which would result if the ends had been forced out of position by lever action.

Valve with 30-Deg. Body

To effect a minimum change in the direction of flow through the valve, the Grove Series V and VL valves have a 30-deg. body design. By having the fluid travel through the valve without undergoing the usual large change in direction, turbulence,



Diagrammatic view of the Globe 30-deg. valve

wire drawing and cutting action are substantially reduced.

A solid one piece stem and plug is employed to effect an absolutely tight shut-off when closed. The valve stem is not directly carried by the hand-wheel to lessen the chance of the stem becoming distorted or bent. All shocks are absorbed by a multiple full-threaded section of the handwheel and yoke. All threaded surfaces and operating parts are protected from paint, dirt and damage by an encasing cap shield. Essential operating parts of the valves have constant lifetime lubrication by a factory-sealed process. The sealed lubricant is zoned entirely away from the flow stream and isolated from temperature effects.

This 30-deg. globe is available for various kinds of use from the Grove Regulator Company, Sixty-fifth and Hollis streets, Oakland, Calif.

Diesel-Drive Control

A new electro-hydraulic governing system for Diesel-electric drives readily adaptable for locomotives, ship propulsion, mobile and stationary power plants, oil well drilling rigs, and industrial uses where Diesel-electric drives are employed, has been developed by the General Electric Company.

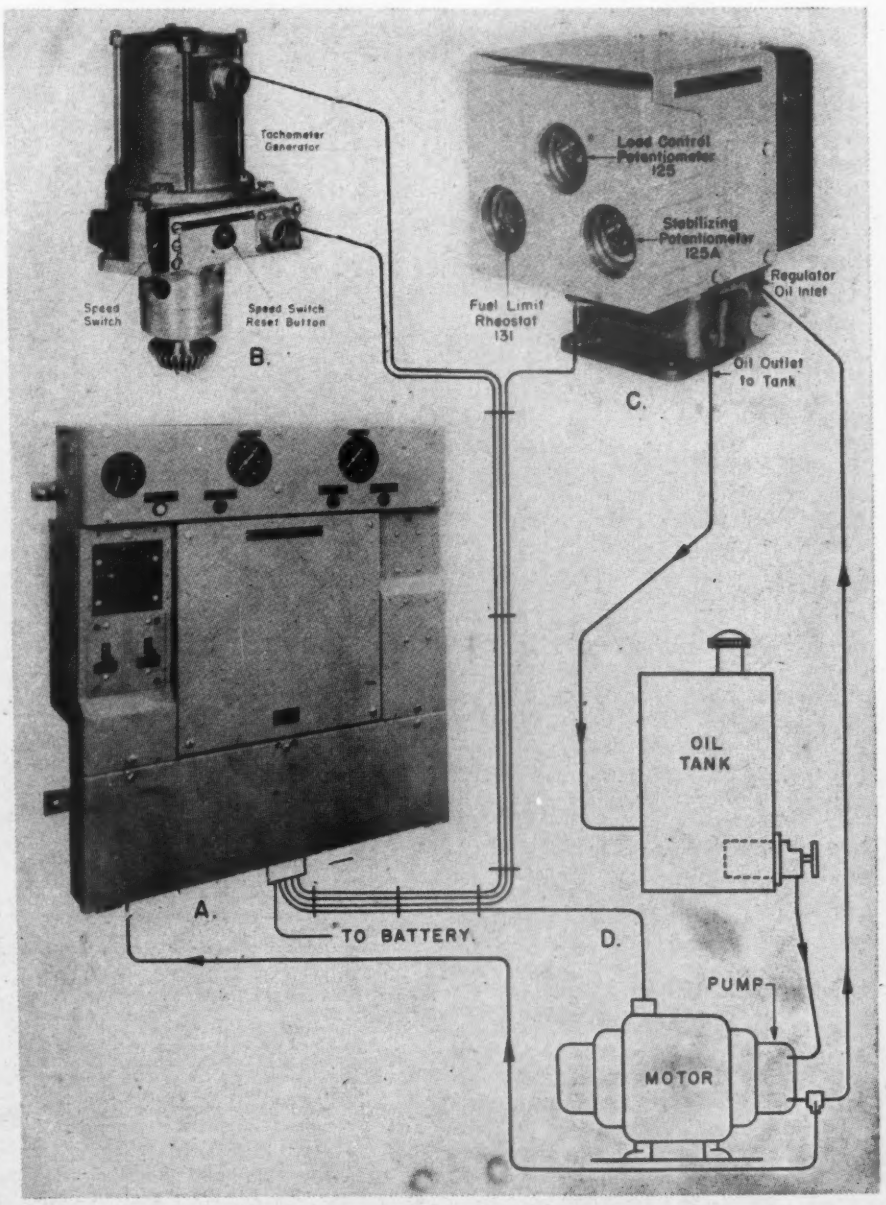
Designed especially for power plant load control, the salient features of the system are exceptional speed control with good stability, highly responsive to changes in generator demand and engine ability, remote control and multiple-unit operation.

Speed measurement is performed by an engine-driven a.c. tachometer generator whose output voltage is proportional to speed. Speed is maintained at pre-set values, by feeding the speed indication to a hydraulic servo-mechanism which controls the engine fuel and generator excitation, and makes possible full utilization of the engine without danger of overloading.

The system operates stably over a wide speed range, and permits the use of the lowest possible engine speed commensurate with power requirements. The use of feedback from the electrical load allows the control to anticipate the speed changes which would be produced by changes in generator demand, and therefore minimizes transient regulation.

Engine protection safety features are built in this new governing system. Overspeed protection is provided by an overspeed trip switch which automatically cuts off the fuel supply when the engine overspeeds. If the engine lubricating oil pressure drops to the danger level, a short-circuiting switch drops the engine speed automatically to idle. Similar type switches function with high temperatures or grounds.

Remote control in this system is readily achieved. The manual and automatic controls may be located at any desired distance from the prime mover. Speed modulation can be infinite or by definite steps as in throttle notches. The engine-speed indicator is remote from the fuel control.



Power Plant Regulating System: A—engine control panel; B—Tachometer generator; C—Power-plant regulator; D—Regulator pressure oil system

NEWS

Judge Fletcher Elected A. A. R. President

At a meeting of the directors of the Association of American Railroads in New York December 12, held in conjunction with a member road meeting, the office of president of the association, made vacant by the recent death of John J. Pelley, was filled by the election of R. V. Fletcher, who agreed to serve until a permanent successor can be found. At the same time J. B. Hill, president of the Louisville & Nashville, was added to the association's executive committee, enlarging its membership to seven.

New members of the A. A. R. board of directors are: George F. Ashby, president, Union Pacific, W. G. Vollmer, president, Texas & Pacific (successors to R. L. Williams, president, Chicago & North Western, and Wilson McCarthy, trustee, Denver & Rio Grande Western), William White, president, Delaware, Lackawanna & Western (successor to R. J. Bowman, president, Chesapeake & Ohio), and E. S. French, president, Boston & Maine-Maine Central (successor to H. S. Palmer, president and trustee, New York, New Haven & Hartford).

Seven R. R. Div. Members Made Fellows of A. S. M. E.

At the luncheon of the Railroad Division, American Society of Mechanical Engineers, held on December 5 during the annual meeting of the society at New York, the following members of the division were made fellows of the society: E. D. Campbell, vice-president in charge of engineering, American Car and Foundry Company; William A. Newman, manager, research department, Canadian Pacific; Ralph P. Johnson, chief engineer, Baldwin Locomotive Works; A. G. Trumbull, chief mechanical engineer, Chesapeake & Ohio; William M. Sheehan, vice-president, General Steel Castings Corp.; F. H. Hardin, president, Association of Manufacturers of Chilled Car Wheels, and Carlton D. Stewart, vice-president, Westinghouse Air Brake Co.

The citations were read by President D. Robert Yarnall, president, Yarnall-Waring Company. In the absence of Messrs. Sheehan and Hardin, the awards were accepted by Charles P. Whitehead, president, General Steel Castings Corp., and Paul W. Kiefer, chief engineer motive power and rolling stock, New York Central.

Coal Institute to Use Kaiser Plant for Turbine Tests

Full-scale operational tests of the combustion apparatus and fly-ash separators for the coal-burning railroad gas turbine will be made at the Kaiser steel mill at Fontana, Calif., according to the Bituminous Coal Institute. The tests will be conducted in cooperation with the Northrop-Hendy Company, a subsidiary of Northrop Aircraft and Joshua Hendy Machine Works.

The steel plant in California is presently the only available source for compressed air in the great quantity needed for the powdered-coal burning combustion tests, according to John I. Yellott, director of the development project. Full-scale equipment is expected to be built in the East this winter for burning pulverized coal under pressure at a rate of 3,000 lb. per hour. It will then be transported to the steel works at Fontana.

The tests are intended to provide actual operating experience on the equipment for the two experimental gas-turbine locomotives soon to be built. Gas turbines of 3,750 shaft horsepower are being constructed by the Allis-Chalmers Manufacturing Company and the Elliott Company. Such preliminary testing in California of the combustion equipment should enable the gas-turbine locomotives to go on the rails early in 1948, according to Mr. Yellott.

Orders and Inquiries for New Equipment Placed Since the Closing of the December Issue

Locomotive Orders

Road	No. of locos.	Type of loco.	Builder
Copper Range	2	1,000-hp. Diesel-electric switch	Baldwin Loco. Wks.
International-Great Northern	1	2,000-hp. Diesel-electric pass.	Electro-Motive
Kansas City Public Service Co.	1	656-hp. electric frt.	General Electric
Lake Terminal	8	1,000-hp. Diesel-electric switch	Electro-Motive
Pennsylvania	11	6,000-hp. Diesel-electric pass.	Baldwin Loco. Wks.
	3	600-hp. Diesel-electric switch	American Loco. Co.

Freight-Car Orders

Road	No. of cars	Type of car	Builder
American Refrigerator Transit Co.[1]	900	40-ton refrigerator	Pullman-Standard
	900	40-ton refrigerator	General American
	200	40-ton refrigerator	Mo. Pac. Shops
Boston & Maine	500	50-ton box	Pullman-Standard
Central of Pennsylvania	1,250	50-ton box	American Car & Fdry.
Chicago Great Western	500	50-ton box	Pullman-Standard
Maine Central	250	50-ton box	Pullman-Standard
Missouri Pacific	800	50-ton box	Pressed Steel Car
	50	70-ton covered hoppers	American Car & Fdry.
	500	70-ton hopper	American Car & Fdry.
	918	Various type	Co. shops

Freight-Car Inquiries

Kansas City Southern	800	50-ton box	
New York, New Haven & Hartford	500	50- or 60-ton box	

Passenger-Car Orders

Canadian National	30	Streamline coaches	Canadian Car & Fdry.
Chesapeake & Ohio Lines[2]	99	Coaches	Pullman-Standard
	22	Coach-baggage	Pullman-Standard
	3	Mail-baggage	Pullman-Standard
	4	Parlor	Pullman-Standard
	10	Single driving	Pullman-Standard
	14	Two-unit dining (28 cars operated in pairs)	Pullman-Standard
	2	Tavern-lounge	Pullman-Standard
Chicago, Rock Island & Pacific-Southern Pacific	2[4]	Baggage-dormitory	Pullman-Standard
	6[4]	"Day-nite" coaches	Pullman-Standard
	2[4]	Coffee-shop-lounge	Pullman-Standard
	2[4]	Dining	Pullman-Standard
	2[4]	Drawing-room, bedroom, compartment-sleeper	Pullman-Standard
	2[4]	Roomette sleeping	Pullman-Standard
	4[4]	Bedroom sleepers	Pullman-Standard
	2[4]	Buffet-lounge-observation	Pullman-Standard
Great Northern-Chicago, Burlington & Quincy	5[3]	Mail-baggage	Pullman-Standard
	5[3]	60-seat coaches	Pullman-Standard
	15[3]	48-seat coaches	Pullman-Standard
	5[3]	Coffee-shop	Pullman-Standard
	5[3]	Dining	Pullman-Standard
	20[3]	Sleeping	Pullman-Standard
	5[3]	Observation-lounge	Pullman-Stanadrd
Railway Express Agency	500[7]	50-ton express refrigerator	American Car & Fdry.

[1] Owned jointly by the Missouri Pacific and the Wabash.

[2] Chesapeake & Ohio, Pere Marquette, and New York, Chicago & St. Louis.

[3] For five 12-car streamline trains—four for the Great Northern and one for the C. B. & Q.—for service between Chicago and the Pacific Northwest. Each train will be powered by a two-unit, 4,000-hp. Diesel locomotive constructed by the Electro-Motive Division of General Motors Corporation. The fleet will cost $7,000,000.

[4] For two 11-car, streamlined, stainless-steel trains for service between Chicago and Los Angeles, Calif. The Rock Island and the Southern Pacific also have new equipment on order to augment the present streamlined "Golden State Limited." Included are new reclining-seat coaches, dining cars, coffee-shop-lounge cars, club cars and observation cars. Another new train scheduled to begin service during this period will operate over the Rock Island between Chicago and Omaha, Neb., on a fast daylight schedule. Equipment of the new trains will consist of a baggage-dinette cars, a 76-seat chair car, two 68-seat chair cars and a parlor-observation-buffet car between Chicago and Omaha; and two additional 68-seat chair cars and a parlor car to operate between Rock Island, Ill., and Chicago. The Rock Island has on order with Pullman-Standard 57 passenger cars as follows: 5 roomette bedroom; 3 bedroom-lounge-observation; 2 bedroom; 1 drawing room, bedroom, compartment; 1 roomette; 1 diner-lounge-observation; 2 parlor-buffet-observation; 1 coach-buffet-parlor-observation; 1 parlor; 4 dining; 3 coffee-shop-lounge; 11 night coaches; 16 day coaches; 1 baggage-dormitory; 3 baggage-mail and 2 baggage.

[7] The cars, to cost $7,500,000, will be adaptable to the carrying of merchandise express traffic or may be equipped with auxiliary hot-water heaters to protect perishables in freezing weather. Their normal capacity, 50 tons, will permit a payload of about 62,000 pounds at speeds of 100 m.p.h. Deliveries will begin in the second quarter of 1947.

Orders for 4,000 journal bearings to equip these cars have been placed with the Timken Roller Bearing Company. The bearings are of the Quad type.

1947 Machine Tool Show

THE fourth Machine Tool Show will be held by the National Machine Tool Builders' Association at Chicago, September 17 to September 26, 1947, inclusive. Saul Poliak, 37 Wall street, New York 5, is in charge of exhibit arrangements.

Electronic Temperature Controls for New C. & O. Cars

THE Chesapeake & Ohio has announced that a new advanced electronic temperature control system will be specified for the 284 new passenger cars which are being built by the Pullman Standard Car Manufacturing Company, for the Chesapeake & Ohio, the Pere Marquette, and the Nickel Plate under their recent joint order reported in *Railway Age* of November 23, page 902.

The new control system which the C. & O. is the first railroad to adopt, was developed by engineers of the Minneapolis-Honeywell Regulator Company. It utilizes panel radiant heating and a new principle of modulation.

In the electronic system, regarded by heating engineers as a highly significant development for passenger trains, thermostats are installed against the outside skin of the car. They respond to slight changes in weather, even the effects of shade and sun, and work in conjunction with other thermostats located inside the car to provide a close control over the flow of hot or cold air. The electronic thermostats are sensitive to one-tenth of a degree of temperature.

Miscellaneous Publications

SHOT PEENING. — American Wheelabrator & Equipment Corp., Mishawaka, Ind. 128 pages, 6 in. by 9 in. Nominal price $1.50. This book, for the use of engineers and production men, contains a detailed explanation of the shot-peening process. Part I discusses the applications and advantages of shot peening and the equipment and procedures involved. Part II covers the theory of prestressed surfaces in relation to shot peening. A glossary defines the terms used in the book.

Supply Trade Notes

SIMMONS-BOARDMAN PUBLISHING CORPORATION.—*James G. Lyne* has been appointed to the new office of assistant to chairman of the Simmons-Boardman Publishing Corporation with such authority and duties as the chairman shall give him. He will continue as heretofore to be vice-president of the corporation and assistant to the editor of Railway Age. Mr. Lyne was born at St. Louis, Mo., on July 10, 1898. He grew up at Herington, Kans., where his father was a conductor on the Chicago Rock Island & Pacific. He was educated at

J. G. Lyne

the University of Kansas (A. B. 1920) and New York University (Ph.D. 1946). He entered railway service in 1914 as a laborer in the car department of the Rock Island at Herington and served for fifteen months in that capacity, and as material clerk, timekeeper, file clerk, and M. C. B. clerk. He worked during summer vacations when at college for the Rock Island as extra gang timekeeper, rodman, ballast inspector and extra clerk in the office of the superintendent at Herington and in the general enginehouse foreman's office at Kansas City, Kans. He was a special agent of the Bureau of Labor Statistics, Washington, D. C., 1919-1920, and a reporter on the New York Daily News in 1920. He was an associate editor of the Railway Age 1920-1928; financial editor 1928-1938; has been assistant to the editor of the Railway Age since 1938, and vice-president and director of the Simmons-Boardman Publishing Corporation since 1943.

◆

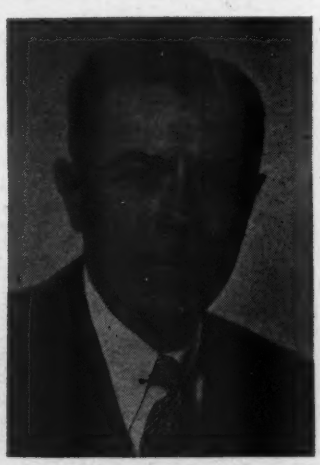
JOSEPH T. RYERSON & SON, INC.—*Joseph T. Ryerson & Son, Inc.*, has announced the completion of a new office building at its Pittsburgh, Pa., steel service plant.

◆

AJAX CONSOLIDATED COMPANY. — *W. Downing Messimer* has been appointed direct factory representative for the Ajax-Consolidated Company on railroads in the northeastern section of the country, with headquarters in New York.

◆

MACLEAN-FOGG LOCK NUT COMPANY.—*Joseph J. Murphy* has been appointed manager of sales of the MacLean-Fogg Lock Nut Company, Chicogo. Mr. Murphy was



Joseph J. Murphy

born at Chicago in 1904, and received his elementary education in that city. He is a graduate of Dartmouth college (1925). He was in the investment business for 10 years before entering railway sales work. He joined MacLean-Fogg in 1943 as sales representative at Chicago.

STANDARD RAILWAY EQUIPMENT MANUFACTURING COMPANY.—*D. C. Webster* has joined the Standard Railway Equipment Manufacturing Company as assistant chief

D. C. Webster

engineer, with headquarters at Hammond, Ind.

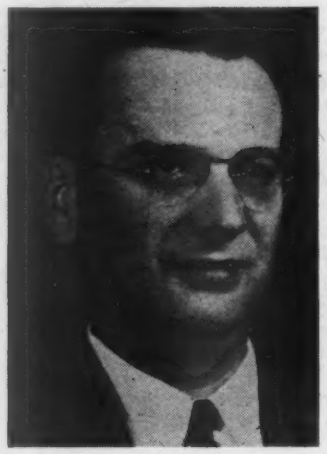
D. C. Webster was born at Ogden, Utah. He received most of his primary education at Omaha, Neb., and is a graduate of the University of Nebraska (1934), with a B. S. degree in civil engineering. Before entering college, he was an office boy and laborer in the employ of the Union Pacific at Omaha. From 1928 to 1930, he served in the mechanical and stores departments at Laramie, Wyo., and Cheyenne, and, later, in the engineering, bridge and building, and maintenance-of-way departments. In 1935 he entered the employ of the Pacific Fruit Express Company, of which company he was engineer of car construction at the time of his appointment as assistant chief engineer of the Standard Railway Equipment Manufacturing Company.

◆

AMERICAN K. A. T. CORPORATION.—*Taylor-Reed & Co.*, 915 Olive street, St. Louis 1, Mo., have been appointed sales-engineering representatives, railroad division of the American K. A. T. Corporation.

BUDD COMPANY.—*Edward G. Budd, Jr.* has been elected president of the Budd Company, to succeed his father, who died on November 30, as noted in the obituary columns of this issue.

Edward G. Budd, Jr., a graduate of Wesleyan university in 1923, joined the



Edward G. Budd, Jr.

Budd Company in that same year. He was elected vice-president in 1934; a director in 1938, and executive vice-president, in 1943.

◆

GLOBE STEEL TUBES COMPANY. — *Lee Mullen* has been appointed general manager of sales for the Globe Steel Tubes Company. Mr. Mullen, previous to his association with Globe Steel in 1934, served in the em-

Lee Mullen

ploy of the Sharon Steel Company, the Republic Steel Corporation, and the Pittsburgh Steel Company.

◆

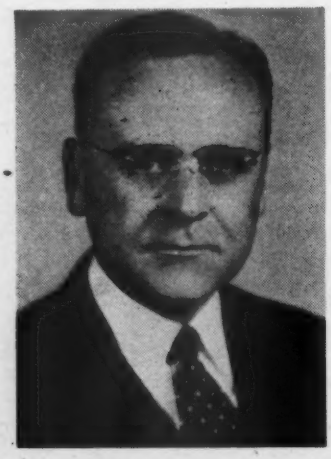
AMERICAN BRAKE SHOE COMPANY. — *John S. Hutchins*, president of the Ramapo Ajax division of the American Brake Shoe Company, *William T Kelly, Jr.*, president of the engineered castings division and the Kellogg division, *Thomas W. Pettus*, president of the national bearing division, and *Joseph B. Terbell*, executive vice-president of the American manganese steel division, have been elected vice-presidents of the American Brake Shoe Company.

John S. Hutchins, a native of Arlington, Mass., has been with American Brake Shoe for 21 years, mainly in a sales capacity. He

John S. Hutchins

was elected a vice-president of the Ramapo Ajax division in January, 1944, and president in September, 1945. Since December, 1945, he also has been chairman of the Canadian Ramapo Iron Works, Ltd.

William T. Kelly, Jr., who joined American Brake Shoe in 1928, was general purchasing agent for several years before becoming president of the Kellogg and engineered castings divisions. Mr. Kelly, who



William T. Kelly, Jr.

was born in Mobile, Ala., is also vice-president of the Canadian Ramapo Iron Works and a director of the Dominion Brake Shoe Company, Ltd.

Thomas W. Pettus, president of the national bearing division since February, 1945, has been employed by American Brake Shoe, successively, as sales representative, sales manager, priorities administrator, vice-president and executive vice-president of the national bearing division. He is a native of St. Louis, Mo.

Thomas W. Pettus

Joseph B. Terbell has been associated with various divisions of the company, mainly in a sales capacity. In 1940, he was

Joseph B. Terbell

promoted from the position of district sales manager to vice-president of the American manganese steel division, and in December, 1945, was elected executive vice-president. Since January, 1946, he has also been a director of Dominion Brake Shoe.

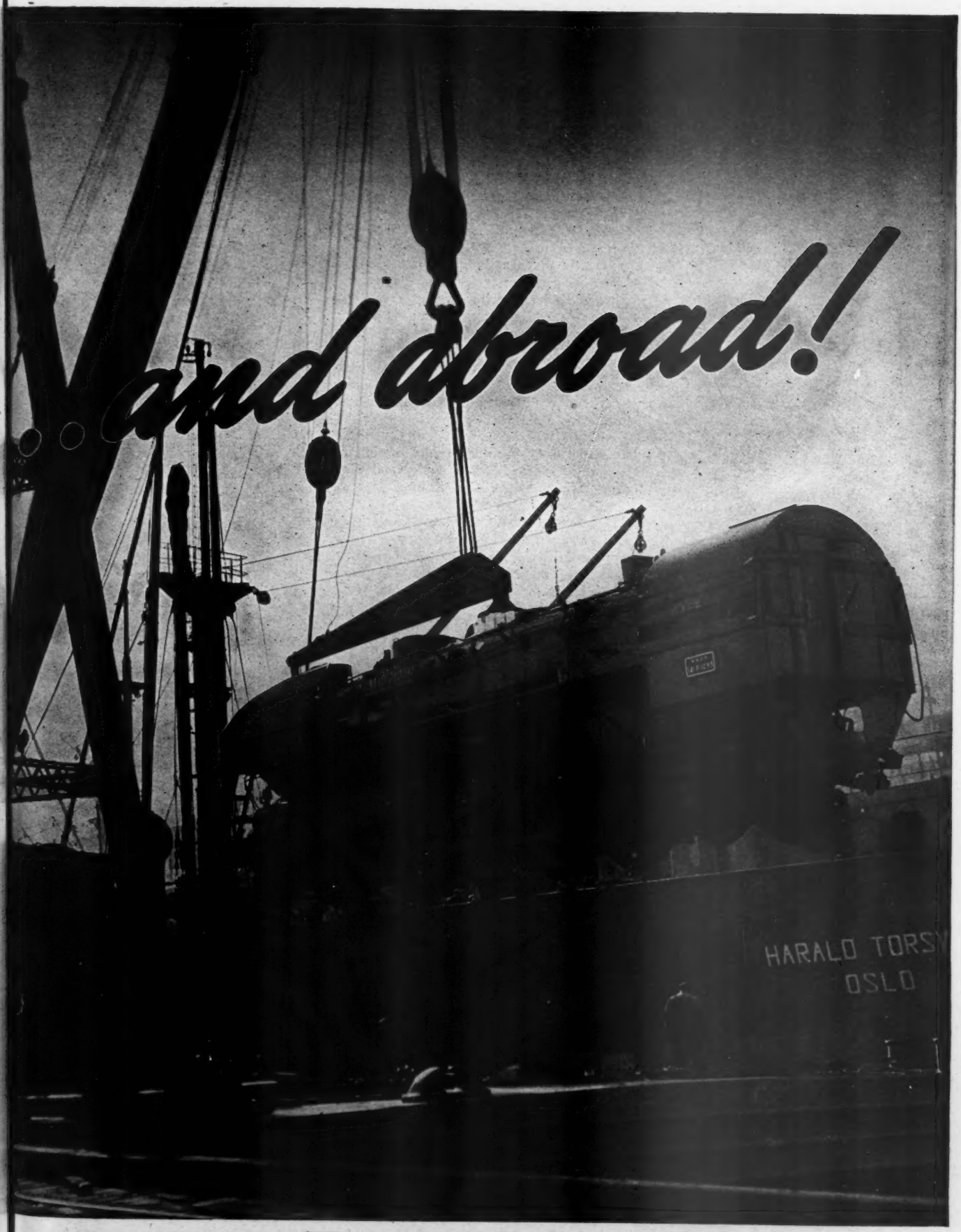
◆

HYSTER COMPANY.—*Ray Ronald* has been appointed Western division sales manager of the Hyster Company, with headquarters at Portland, Ore. *Clarence H. Collier, Jr.*, has been appointed manager of the industrial lift truck eastern division, with headquarters in Peoria, Ill.

Dan J. Sheehan has been appointed manager of the Danville, Ill., plant of the

Dan J. Sheehan

Hyster Company. Mr. Sheehan, as a graduate of the University of Michigan with a degree in mechanical engineering, taught that subject for three years at Purdue university. For the past 14 years he has been superintendent of motive power of the Chicago & Eastern Illinois.



INCORPORATED, LIMA, OHIO

AMERICAN HAIR & FELT COMPANY.—*James C. Younglove*, sales manager of the Railroad Division, American Hair & Felt Company, at Chicago, has retired. He joined the company as sales manager in 1931.

James C. Younglove

James C. Younglove was born on August 7, 1879, at Crescent, N. Y. He began his career in 1902 as a local manager of the railroad sales department of the Johns-Manville Sales Corporation at Chicago. He later advanced to assistant general manager and to general manager of the railroad department, and served also as a director of the company for eight years. In 1930 he joined the American Hair & Felt Company as sales manager of the Railroad Division.

◆

PITTSBURGH PLATE GLASS COMPANY, MORCK BRUSH DIVISION.—The Pittsburgh Plate Glass Company has announced the purchase of the Morck Brush Manufacturing Company of San Francisco, Calif., which will be operated as the Morck brush division. *Frank F. Tippett*, formerly with the Baltimore, Md., brush plant of Pittsburgh Plate Glass, has been appointed manager of the new division.

◆

INDEPENDENT PNEUMATIC TOOL COMPANY.—*J. A. Hill*, formerly manager of the New York branch office of the Independent Pneumatic Tool Company, has been appointed manager of electric-tool sales, with headquarters in Chicago. *W. C. Rush*, formerly in the St. Louis, Mo., branch, has been appointed manager of a newly opened office at 426 Elm street, Cincinnati, Ohio.

◆

SYLVANIA ELECTRIC PRODUCTS, INC.—*Milton E. Lauer*, production planning manager of Sylvania Electric Products, Inc., has been appointed to the newly created position of production manager of the radio tube division. The electronic tubes, laboratory, industrial and electronic devices for communication appliances manufactured by Sylvania will be distributed in Canada through Stromberg-Carlson, Ltd.

◆

EAST CHICAGO MACHINE TOOL CORPORATION.—Formation of the East Chicago Machine Tool Corporation, with headquarters at 4722 Railroad avenue, East Chicago, Ind., has been announced by *W. L. Fox*, president of the new concern. Mr. Fox resigned as superintendent of the Belt Railway of Chicago and the Chicago & Western Indiana in July, 1944, to become vice-president of the Coach & Car Equipment Corp., Chicago. He left the latter position on June 10, 1946, to become president of the Famous Manufacturing Company, in which position he continues.

◆

LANDIS TOOL COMPANY.—The Landis Tool Company, Waynesboro, Pa., has opened an office at 3091 Mayfield Road, Cleveland 18, Ohio. *P. E. Beaver*, manager of the new office, represented Landis in England before World War II and upon his return was located at Chicago.

◆

TIMKEN ROLLER BEARING COMPANY.—*Elmer Anderson*, service engineer of the Timken Roller Bearing Company, at Milwaukee, Wis., has been appointed assistant service manager at Canton, Ohio.

◆

PITTSBURGH STEEL FOUNDRY CORPORATION.—*R. J. Leckrone* has been appointed chief engineer in charge of engineering and machinery sales for the Pittsburgh Steel Foundry Corporation, Glassport, Pa. Mr. Leckrone was formerly chief designing engineer for the Lewis Foundry and Machine division of the Blaw-Knox Company.

◆

NATIONAL BRAKE COMPANY.—*A. H. Adkins* has been appointed southeastern sales representative for Peacock hand brakes, a product of the *National Brake Company*. His headquarters will be at Bethesda, Md.

◆

GALVIN MANUFACTURING CORPORATION.—*Paul K. Povlsen*, formerly vice-president in charge of production and engineering for the J. I. Case Company, has been appointed assistant to the president of the *Galvin Manufacturing Corporation* of Chicago. *Walter B. Scott* has been appointed assistant to Mr. Povlsen. Mr. Scott was formerly assistant to Mr. Povlsen with the Case Company.

◆

AMERICAN ROLLING MILL COMPANY.—*R. C. Todd, G. F. Ahlbrandt* and *Anson Hayes* have been elected vice-presidents of the American Rolling Mill Company. Mr. Todd and Mr. Ahlbrandt were formerly assistant vice-presidents of the company and Mr. Hayes served as director of research since 1929.

◆

REYNOLDS METALS COMPANY.—*Edward A. Sipp* has been appointed manager, railway division, of the Reynolds Metals Company, with headquarters at Chicago. Mr. Sipp was formerly contact executive of the Gustin-Bacon Manufacturing Co., and for many years was associated with Pyle-National Company.

◆

SCULLIN STEEL COMPANY.—*Torsten H. Parke* has been appointed to the sales department, in charge of the New York office, of the *Scullin Steel Company*, to succeed the late *Brownrigg L. Norton*, deceased.

◆

UNION ASBESTOS & RUBBER CO.—*Ralph W. Payne Company*, Washington, D. C., has been appointed regional representative of the Equipment Specialties Division of Union Asbestos & Rubber Co., Chicago, for the sale of Equipco hand brakes for freight cars.

COLORADO FUEL & IRON CORPORATION.—*William S. Boyce* has been appointed manager, railroad sales, of the Colorado Fuel & Iron Corp., at Denver, Colo.

◆

LINK-BELT COMPANY.—*George P. Torrence*, executive vice-president of the Link-Belt Company, Chicago, has been elected president to succeed *William C. Carter*, who continues as a director of the company and chairman of its board of directors' executive committee.

◆

BLAW-KNOX COMPANY.—*Robert A. Wahl* has been appointed sales manager of the Union steel castings division of the Blaw-Knox Company.

Robert A. Wahl is a graduate of the Shenandoah Valley Academy and the Ohio

Robert A. Wahl

State University. After graduation he spent five years with various industrial companies. Since 1937, when he joined Blaw-Knox, he has served in a number of purchasing and sales capacities.

◆

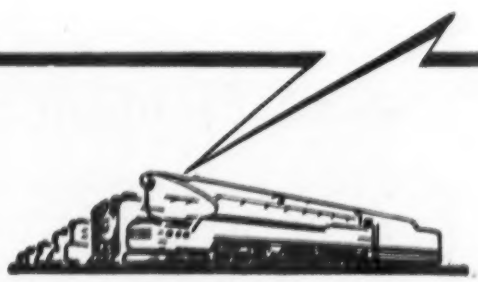
WESTINGHOUSE ELECTRIC CORPORATION.—*Eugene N. Foss, 2nd*, has been appointed manager of the northwestern district of the B. F. Sturtevant Company division of the Westinghouse Electric Corporation to succeed Fred Herlan, who will retire soon. Mr. Foss, from headquarters in Chicago, will direct the sale of Sturtevant air-handling and air-conditioning equipment in northern Illinois and Indiana, western Ohio, parts of Michigan, South Dakota and Montana, and all of Wisconsin, Iowa, Minnesota, Nebraska and North Dakota.

Obituary

CHARLES DREW YOUNG, sales manager of the Metal & Thermit Corporation, died on November 16 at the Orange (N. J.) Memorial Hospital after a brief illness. Mr. Young was born in Charles City, Iowa, June 30, 1888. He received his education in the Chicago Public Schools and at Armour Institute of Technology. He joined the Metal & Thermit sales organization in 1911 and in 1930 became district manager in Chicago. In 1943 he was appointed sales manager with headquarters in New York. He was a vice-president of the National Railway Appliances Association, on the board of directors of which he served a number of years, and a member of the

Measure first cost of new locomotives

IN TERMS OF HORSEPOWER



THE day is past when weight and size alone measured a locomotive's ability to perform. Today it is horsepower — horsepower at operating speeds, whether freight or passenger.

The maximum horsepower will be obtained from a steam locomotive of any given design only when that locomotive is equipped with the Franklin System of Steam Distribution. Without increasing size or fuel consumption, this system will increase power by 19 to 30 per cent at operating speed — and is the only means by which this increase can be obtained. Cost, measured in horsepower, will be substantially lowered.

Application of the Franklin System of Steam Distribution, using poppet valves, is practical — to either new or existing locomotives — for either freight or passenger service.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO • MONTREAL

STEAM DISTRIBUTION SYSTEM • BOOSTER • RADIAL BUFFER • COMPENSATOR AND SNUBBER • POWER REVERSE GEARS
AUTOMATIC FIRE DOORS • DRIVING BOX LUBRICATORS • STEAM GRATE SHAKERS • FLEXIBLE JOINTS • CAR CONNECTION

Executive Committee of the Chicago Section of the American Welding Society.

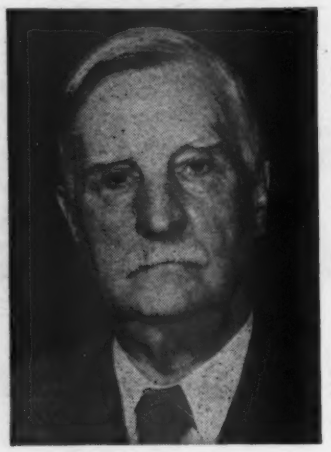
◆

HERBERT W. YOUNG, founder and president of the Delta-Star Electric Company, Chicago, died in that city on November 25. He was 70 years old.

◆

EDWARD GOWEN BUDD, founder and president of the Budd Company, died of a heart attack on November 30 at his home in Philadelphia, Pa. He would have been 76 years old on December 28.

Mr. Budd was born in Smyrna, Del., where he attended the public schools there. In 1887 he began his career as a machinist by serving an an apprentice, first with G. W. & S. Taylors of Smyrna and later with Bement, Miles & Co., Philadelphia, machine-tool builders. While with the latter organization, he took a course with the Franklin Institute, studying the latest forms of gearing. In 1895 he joined the American Pulley Company, where, as shop superintendent, he was credited with the development of the first sheet-metal pulleys. He became associated with the Hale & Kilburn Co., manufacturers of railroad car seats, in 1902, where as general manager he was responsible for the introduction of pressed metal parts as substitutes for castings. Mr. Budd went into business for himself in 1912, founding the Edward G. Budd Manufacturing Company. The first shop was located in a small rented place in Philadelphia. The shop was so small that it was necessary to install a large press in a rented canvas circus tent, which was set up on an adjoining lot. Organized for the development of sheet-metal stampings, the new concern soon began the manufacture of steel-truck and passenger-car bodies. In 1916, Mr. Budd organized the Budd Wheel Corporation for the manufacture of steel



Edward G. Budd

wheels for automobiles. This enterprise was reorganized as the Budd Wheel Company five years later, with its own plant in Detroit. On June 11, 1946, the stockholders of the Budd Wheel Company and the Edward G. Budd Manufacturing Company voted to merge the companies into a single corporate entity, the Budd Company. Mr. Budd, in 1944, received the medal of the American Society of Mechanical Engineers, the society's highest award, for his "outstanding engineering achievements."

◆

JAMES S. WATSON, who retired in March, 1946, as a director of Link-Belt Company, Chicago, and who served as vice-president in charge of Indianapolis (Ind.) plants operations until 1943, died in the latter city on December 10. He was 72 years old, and had been associated with the company for more than 50 years.

◆

JOHN D. WILLIAMSON, New York district manager for SKF Industries, Inc., from 1923 until his resignation last August 31, died on November 2 at his home in Ramsey, N. J. He was 55 years old.

◆

ROSWELL D. GRANT, vice-president in charge of engineering and manufacturing of the Pyle National Company, whose recent death was reported in the December issue, was born on July 4, 1889, at Pentwater, Mich. He began his career with an electrical firm at Grand Rapids, Mich., and joined the Pyle-National Company in 1913 as a draftsman in the engineering department. He was subsequently advanced to the position of plant superintendent, and in 1929 was elected vice-president.

Personal Mention

S. O. RENTSCHLER, superintendent of motive power of the Elgin, Joliet & Eastern at Joliet Ill., has been appointed general manager with headquarters at Chicago. Mr. Rentschler was born at Verdon, Neb., on October 12, 1904, and is a graduate of

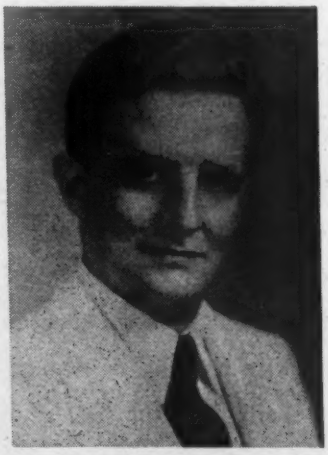
S. O. Rentschler

the University of Nebraska. He entered railway service as a special apprentice in the employ of the Missouri Pacific in September, 1923, subsequently serving as a machinist, division foreman, enginehouse foreman, and general passenger shop foreman at various points, including St. Joseph, Mo., Omaha, Neb., and Lincoln; Wichita, Kan., Hoisington and Ossawatomie, and Kansas City, Mo. After serving as general shop foreman at Sedalia, Mo., Mr. Rentschler in August, 1942, became shop superintendent, with headquarters at Sedalia. On October 1, 1943, he was appointed mechanical superintendent of the Southern district, with headquarters at St. Louis, and in November, 1944, assistant chief mechanical officer. He resigned on April 1, 1945, to become superintendent of motive power of the E. J. & E.

J. A. SHEEDY, master mechanic of the Pennsylvania at Indianapolis, Ind., has been appointed assistant engineer of tests, with headquarters at Altoona, Pa.

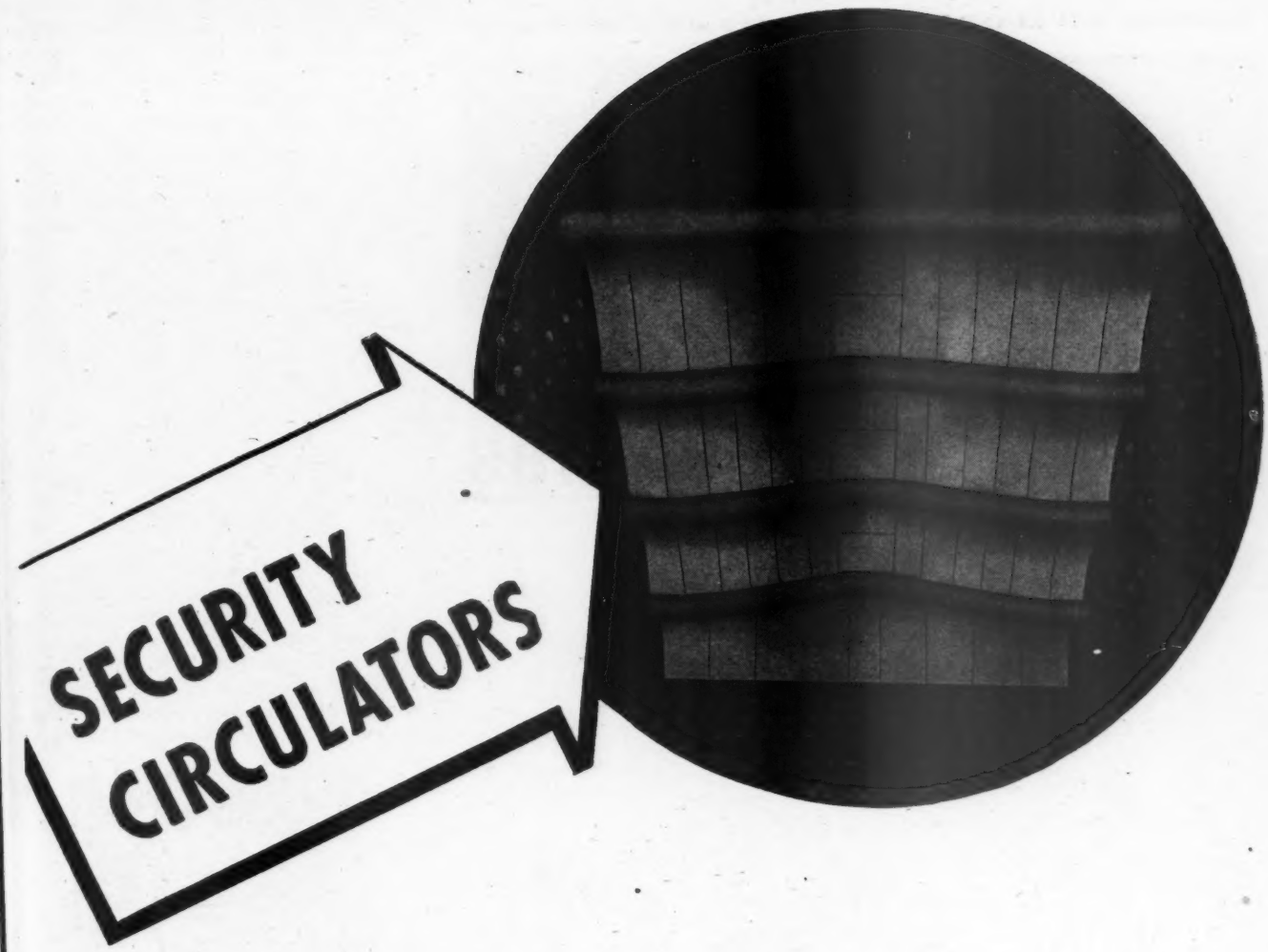
P. H. VERD, master mechanic of the Elgin, Joliet & Eastern at Gary, Ind., has been appointed superintendent of motive power and equipment, with headquarters at Joliet, Ill.

BRUCE C. GUNNELL, whose appointment as chief mechanical engineer of the Southern, at Washington, D. C., was announced in the November issue, was born on December 16, 1907, at Washington. Mr. Gunnell attended elementary and high schools at Ames, Iowa, and is a graduate of the University of Virginia (1932) with B. S. and M. E. degrees in engineering. Entering the service of the Southern in October, 1935, as assistant mechanical engineer at Alexandria, Va., he subsequently served as night enginehouse foreman at Winston-Salem, N. C., Danville, Va., and at Greensboro, N. C. Prior to his association with the



Bruce C. Gunnell

Southern, Mr. Gunnell served for a brief time with the U. S. Army Engineer Corps in various capacities and with the General Chemical Company of Baltimore, Md., as apprentice mechanical engineer. In June, 1942, he was furloughed by the Southern for military service with the Army Trans-



PROLONG THE LIFE OF ARCH BRICK

When Security Circulators were first developed it was for the specific purpose of providing effective support for a 100% brick arch. And experience has proved that the use of Security Circulators greatly prolongs the life of arch brick.

Other important advantages, however, result from the installation of Security Circulators, since they minimize honeycombing, flue plugging and cinder cutting, thus definitely reducing boiler maintenance. They also insure a positive flow of water over the center of the crown sheet.

AMERICAN ARCH COMPANY, INC.

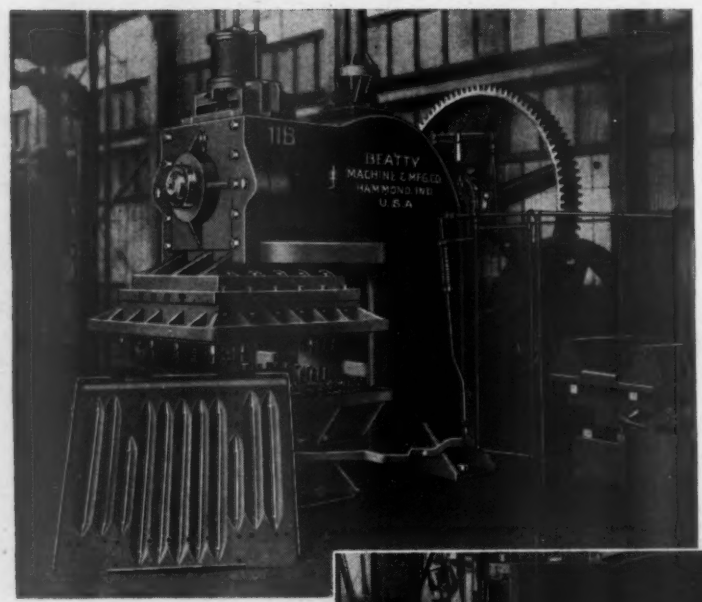
NEW YORK • CHICAGO

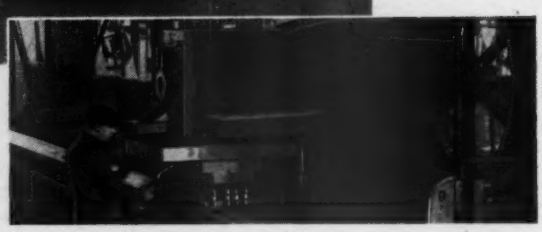
SECURITY CIRCULATOR DIVISION

Exceptionally large die space adapts machine to a wide variety of set-ups

LEADING RAILROAD SHOPS AND CAR BUILDERS USE

BEATTY machines





BEATTY NO. 11-B
MULTIPLE PUNCH AND
SPACING TABLE

A BEATTY heavy duty punch, equipped with special tools, can handle the most complicated punching and slotting requirements in one pass through. It is an important unit in the complete line of BEATTY-ENGINEERED punches, presses, shears, bull-dozers and spacing tables extensively used in your industry. When you have a heavy metal working problem to solve let us give you the benefit of our long and intimate experience in your field.

BEATTY MACHINE AND MFG. COMPANY
HAMMOND, INDIANA

47 (Adv. p. 62)

portation Corps and served in the Middle East, Italy, and England. He received his honorable discharge as a major in December, 1945, and returned to the Southern as Diesel engineer at Washington.

M. R. Reed, assistant chief of motive power-car of the Pennsylvania at Philadelphia, Pa., has been appointed assistant to the chief of motive power, with headquarters at Philadelphia.

R. C. Parsons, assistant vice-president and assistant general manager (transportation and mechanical) of the Louisville & Nashville, at Louisville, Ky., has been appointed to general manager, with headquarters at Louisville.

Clare I. Clugh, superintendent of the Logansport division of the Pennsylvania at Logansport, Ind., has been appointed assistant chief of motive powercar, with headquarters at Philadelphia, Pa. Mr. Clugh was born at Altoona, Pa., and was educated at Valparaiso and Purdue Universities. He entered the service of the Pennsylvania as a machinist apprentice at Altoona in June, 1918, and advanced through various positions at Altoona until 1929, when he was appointed motive power inspector at Harrisburg, Pa. Thereafter, Mr. Clugh served successively as gang foreman at Harrisburg

Clare I. Clugh

and enginehouse foreman at Delmar, Del. He was appointed assistant master mechanic of the Lake division at Cleveland in May, 1937; resident inspector at Pittsburgh, Pa., in July, 1938; chief material inspector at Altoona in February, 1941; master mechanic of the Philadelphia Terminal division in February, 1943, master mechanic at Pitcairn, Pa., on May 1, 1945, and superintendent at Logansport on April 16, 1946.

G. E. Bennett, master mechanic of the Chicago & Eastern Illinois, with headquarters at Danville, Ill., has been appointed superintendent of motive power, with headquarters at Danville.

Master Mechanics and Road Foremen

G. F. Lake has been appointed master mechanic of the Nevada Northern, with headquarters at East Ely, Nev.

Dale A. Rea, assistant road foreman of engines of the Bessemer & Lake Erie at Greenville, Pa., has been appointed road

Crack New Lightweights

Kayo old time-schedules

WITH luxury day coaches, diners and lounge-tavern cars, fresh and new as the morning sun, the Humming Bird and Georgian on the Louisville and Nashville provide genuine de luxe travel at ordinary train rates. That's one big accomplishment.

To add much better running time to these new delights of travel, the L & N powers these trains with 2,000 horsepower General Motors Diesel locomotives. Here is what happened to schedules:

The Humming Bird now makes the trip between Cincinnati and New Orleans in 19 hours. Previously this run took 22½ hours.

The Georgian, jointly operated between St. Louis and Atlanta by the L & N and the Nashville, Chattanooga & St. Louis, makes the trip in 12 hours, 52 minutes. Now it's a morning to evening run. Previously this trip took 18 hours, 40 minutes.

Besides bettering the best previous time by hours, General Motors Diesels also add smooth running, smooth starts and stops, and clean travel.

These time-proven Diesels will continue to uphold the amazing reliability records of other General Motors Diesels. More than a third of all GM Diesels in passenger service have topped a million miles with very high availability and little back-shopping. Some have passed the 3 million mile mark.

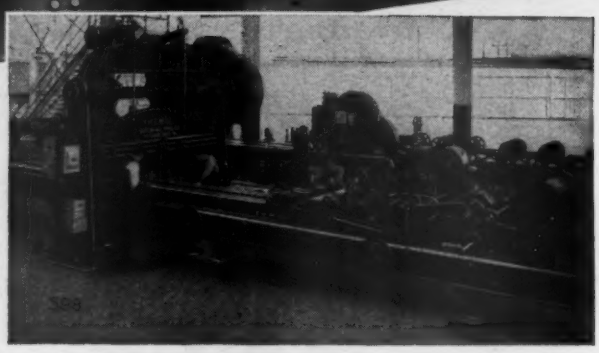
This endurance and ability to maintain fast schedules are built deep into all General Motors Diesels — by men whose skills have been devoted to Diesel locomotives for more than a decade.

GENERAL MOTORS LOCOMOTIVES

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS — LA GRANGE, ILL.

The No. 1 Production Tool!



Available in a wide range of models from completely automatic to hand-operated indicator types.

FOR accurate, economical production of rivet holes in plates or shapes, where quantity output is required, this famous Thomas Spacing Machine is the No. 1 choice of car builders and fabricators.

Write for Bulletin 306 or 306-A

THOMAS
MACHINE MANUFACTURING COMPANY
PITTSBURGH, 23, PA.

If you have a SPECIAL PROBLEM

in any of these operations, where precision work is demanded and where greater production at man-hour savings is paramount—

• BORING—rough, semi-finish and finish • MILLING (special types) • STRAIGHT LINE DRILLING • UNIVERSAL ADJUSTABLE SPINDLE DRILLING • HONING • TAPPING • REAMING • COUNTERBORING • VERTICAL AND WAY-TYPE EQUIPMENT . . .

then a Moline Multiple Spindle Specially Designed machine tool is your answer. Moline tools are ruggedly built and engineered to fit your PARTICULAR requirements, they're made to last for years, they're easy to change over to other jobs, they do better work at less cost and stand up to it longer.

For YOUR special problem, go "HOLE-HOG," write us for any information you may need.

MOLINE TOOL COMPANY
100 20th Street Moline, Illinois

foreman of engines. The position of assistant road foreman of engines has been discontinued.

W. M. MARTIN, general foreman of the Elgin, Joliet & Eastern at Gary, Ind., has been appointed master mechanic, with headquarters at Gary.

J. A. POULIOT, locomotive engineer, Cochrane division of the Canadian National, has been appointed road foreman of engines, Cochrane Division, with headquarters at Parent, Que.

H. W. PROCTOR has been appointed master mechanic of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at St. Paul, Minn.

GEORGE A. BUDGE, general master mechanic of the Chicago, St. Paul, Minneapolis & Omaha (part of the Chicago & North Western System), with headquarters at St. Paul, Minn., has retired, and the positions of general master mechanic and assistant master mechanic have been abolished.

F. ANDERSON has been appointed master mechanic of the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at Sioux City, Iowa.

J. W. MCKINNON, who has been appointed district master mechanic of the Canadian Pacific with headquarters at Toronto, Ont., as noted in the November issue, was born in Kenora, Ont., On August 29, 1891, and received his education in Kenora and Winnipeg, Man. He entered the service of the Canadian Pacific on July 15, 1908, as a machinist apprentice at the Weston Shops, Winnipeg. After working at

J. W. McKinnon

Winnipeg and Brandon, Man., as a machinist, in 1916 he became shop foreman at Kenora where he also served as night foreman. He became back-shop foreman at Fort William, Ont., in 1921; shop foreman at Winnipeg in 1922; locomotive foreman at Medicine Hat, Alta., in 1928; locomotive foreman at Winnipeg in 1932. Mr. McKinnon was appointed division master mechanic in 1935, serving successively at Calgary, Alta., Edmonton, Lethbridge, and Moose Jaw, Sask. He was shop foreman and locomotive foreman at Fort William, Ont., from April, 1942, until August, 1943, when he was appointed division master mechanic,

Trenton Division, Ontario District. He became district master mechanic at Toronto in July, 1946.

OSCAR LEONARD HOPE, who has been appointed master mechanic of the Missouri Pacific at Osawatomie, Kan., as announced in the September issue, was born on September 4, 1902, at Pine Bluff, Ark. He attended high school at Pine Bluff, where he took a special course in mechanical drawing. He entered railroad service on January 12, 1918, as a machinist apprentice in the employ of the St. Louis Southwestern at Pine Bluff. Upon the completion of his apprenticeship on July 1, 1923, he served successively as machinist on two roads—the St. Louis-San Francisco at Sherman, Tex., and the Union Pacific at Salina, Kan.—until September 15, 1923, when he entered the employ of the Missouri Pacific as a

Oscar L. Hope

machinist at Hoisington, Kan. On May 15, 1924, Mr. Hope was transferred to St. Louis, Mo., and on July 21, 1924, to North Little Rock, Ark. He was appointed a federal inspector at North Little Rock on February 15, 1931, and on April 16, 1934, returned to the shops of the Missouri Pacific at North Little Rock as assistant enginehouse foreman. He was appointed enginehouse foreman on January 1, 1938; general foreman on July 9, 1944, and master mechanic at Osawatomie on August 1, 1946.

M. H. LINGENFELTER, assistant master mechanic of the Pennsylvania, at Pittsburgh, Pa., has been appointed master mechanic with headquarters at Indianapolis, Ind.

G. C. KISTNER, master mechanic of the Atchison, Topeka & Santa Fe at Dodge City, Kan., has been transferred to the position as master mechanic at Clovis, N. M.

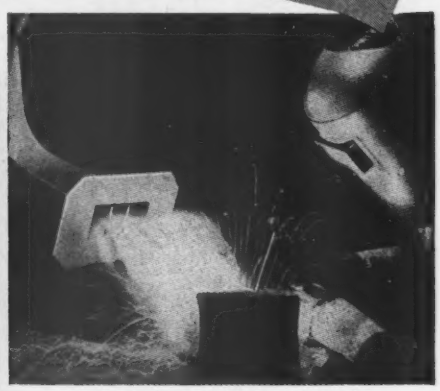
BURTON F. BARNHART has retired as road foreman of engines of the Bessemer & Lake Erie at Greenville, Pa., after 44 years of service on that road.

Car Department

V. G. SMALL has been appointed assistant superintendent of car department of the Elgin, Joliet & Eastern, with headquarters at Joliet, Ill.

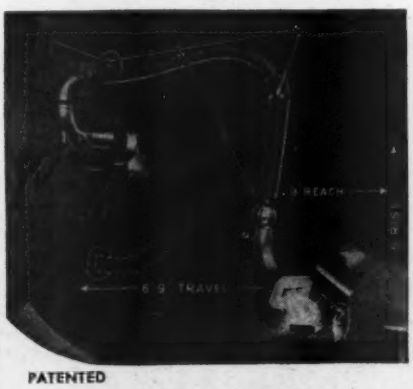
Why the RUEMELIN FUME COLLECTOR *is a* REAL NECESSITY

● *THE OLD WAY*



● *THE NEW WAY*

SOME PROMINENT USERS —
SANTA FE RAILWAY SYSTEM
PENNSYLVANIA RAILROAD
INTERNATIONAL NICKEL COMPANY
JONES-LAUGHLIN STEEL COMPANY
NEW JERSEY ZINC COMPANY
MORGAN-SMITH COMPANY
ANCHOR HOCKING GLASS CO.
SINCLAIR REFINING COMPANY
INLAND STEEL CORP.
OLIVER IRON MINING CO.
NATIONAL LEAD COMPANY
MASSEY HARRIS COMPANY
MARQUETTE CEMENT MFG. CO.
MAYNARD ELECTRIC STEEL CASTING CO.



PATENTED

TWO MODELS!

- Long reach Model D-5342 — ideal for large welding booths; reaches out 15 feet from wall.
- Standard Model D-5310—used for standard welding booth ventilation; hood reaches out 9 feet from wall.

The Ruemelin Welding Fume Collector has been specially engineered to eliminate noxious fumes. The inlet hood maintains a constant high velocity over the working area, quickly removing heat and smoke *at the source.* Welders equipped with this device are assured of a clean shop atmosphere; the manufacturer gains by increased daily production.

The fume collector hood can be instantly placed where needed anywhere in the booth welding area. No tedious adjustment necessary. Just pull the inlet hood to the welding position and you are ready to go. Approved by state industrial commissions and by compensation insurance companies. Many users send in repeat orders. Write for bulletin 37-C today.

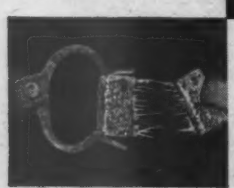
RUEMELIN MANUFACTURING CO.
3982 N. PALMER ST. • MILWAUKEE 12, WISCONSIN
Manufacturers and Engineers of Sand Blast and Dust Collecting Equipment

SEND FOR this Brickseal coated BRICK

Brickseal penetrates the pores and joints of firebrick and forms a highly glazed ceramic coating many times harder than the brick.

Tough and semi-plastic under heat, it prevents cracking and spalling regardless of temperature change—heat the sample and douse in cold water any number of times.

Brickseal resists abrasion. Force the sample brick, either hot or cold, against an emery wheel and see the difference on the coated and uncoated sides.



Brickseal is a superior mortar for fire walls. Try to pull the sample bricks apart after they are heated to 2200°.

Write today for a free sample. No obligation, of course.

Brickseal

REFRACTORY COATING

5800 So. Hoover Street, Los Angeles, Calif.
1029 Clinton Street, Hoboken, New Jersey

W. A. EMERSON, general master car builder of the Elgin, Joliet & Eastern at Joliet, Ill., has been appointed superintendent of car department, with headquarters at Joliet.

E. F. FELSBURG, foreman car shop, Pennsylvania, at Philadelphia, Pa., has been promoted to the position of general foreman, Sunnyside Yard, Long Island City, N. Y.

Electrical

R. H. HART, electrical engineer of the Canadian Pacific at Winnipeg, Man., has retired.

L. T. PATRICK, electrical foreman of the Canadian Pacific, at Moose Jaw, Sask., has been appointed electrical engineer, Western lines, with headquarters at Winnipeg, Man.

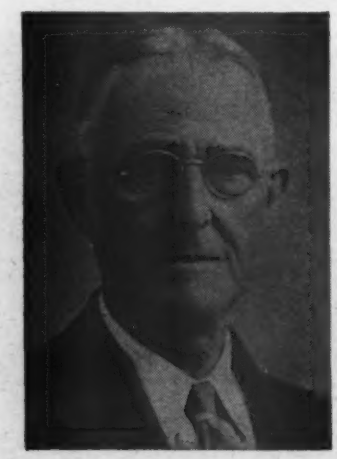
H. A. KEMP, electrical inspector of the Canadian National, at Winnipeg, Man., has been appointed electrical engineer, Western region, with headquarters at Winnipeg.

Shop and Equipment

BERNARD C. KING, general boiler inspector of the Northern Pacific at St. Paul, Minn., has retired after 55 years of railroad service, and 40 years with the Northern Pacific.

H. R. BARCLAY, assistant general boiler inspector of the Northern Pacific, at St. Paul, Minn., has been appointed general boiler inspector with headquarters at St. Paul.

FRANK M. A'HEARN, general locomotive foreman of the Bessemer & Lake Erie at Greenville, Pa., has retired after 50 years of service on that road. Mr. A'Hearn was born at Greenville on November 1, 1876. His education consisted of some high-school as well as night-school training. He entered the employ of the Pittsburgh, Shenango & Lake Erie (now the B. & L.E.) as a machinist on October 1, 1895. He became



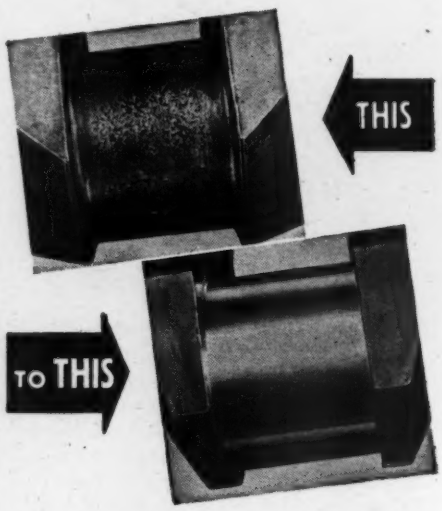
F. M. A'Hearn

assistant machine shop foreman on January 25, 1903; machine shop foreman on September 1, 1906; assistant general locomotive foreman on June 16, 1917, and general locomotive foreman on August 1, 1933. Mr. A'Hearn is the author of the "Highball Scott" series of stories which appeared in 1928 and 1929 issues of the *Railway Mechanical Engineer*.

Don't SCRAP Crankshafts

RECLAIM THEM WITH THE . . .

BINGHAM SLEEVING PROCESS*



● You no longer need to commit all crankshafts to the scrap heap because journals are badly scored or burned. Many can be renewed to manufacturers' specifications by the new Bingham Sleeving Process. Saves *thousands* of dollars in motive power maintenance by prolonging crankshaft life. Let us send you the details.

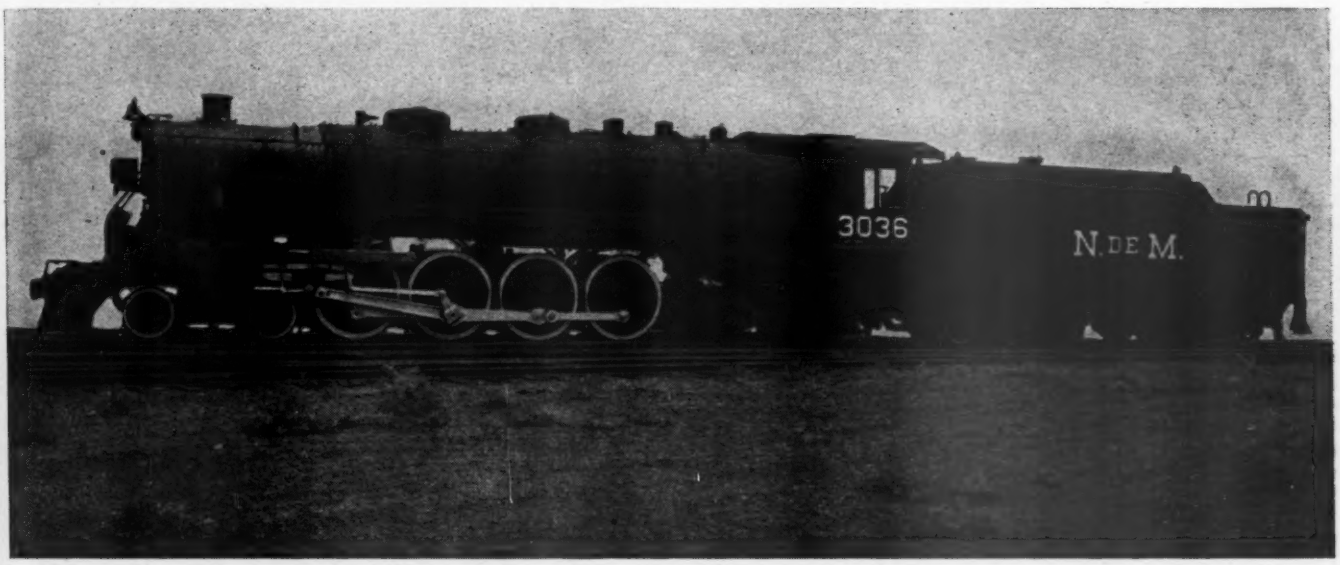
For prices and literature, write today to Department RME-1

paxton

DIESEL ENGINEERING COMPANY
Omaha 5, Nebraska

* Pat. Applied For

thirty-two new locomotives go on Timken Roller Bearings



for NATIONAL RAILWAYS of MEXICO

Continuing their program of motive power modernization, the National Railways of Mexico recently took delivery of 32 new Class QR-1 type 4-8-4 steam locomotives similar to the one pictured above; 16 were built by American Locomotive Company and 16 by Baldwin Locomotive Works. All engine trucks, driving axles and trailer trucks are equipped with Timken Roller Bearings.

These locomotives are designed for both freight and passenger service, in the achievement of which roller bearings are important factors. The Timken Locomotive (the world's first roller bearing locomotive) proved conclusively that by eliminating axle friction it is possible to design engines that will operate efficiently and economically in both capacities. Also a part of this modernization program was equipping 65 new passenger cars with Timken Roller Bearings on all axles. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TAPERED ROLLER BEARINGS

Silicone News

DC

DC Silicone Insulation
Extends Life of
Electro-magnetic Brake

PHOTO, COURTESY DYNAMATIC CORPORATION, SUBSIDIARY OF EATON MANUFACTURING COMPANY

Protects water cooled field coil in this magnetic field member.

In producing electro-magnetic brakes for well drilling rigs, the Dynamatic Corporation, of Kenosha, Wisconsin, tested and adopted DC Silicone Insulation. Moisture infiltration limited the life of coils treated with organic varnishes. Protected by DC 996, none of these coils has failed.

These brakes exert a variable and controllable retarding effect without friction or wearing parts. Fundamentally, they involve the rotation of an iron drum through a variable magnetic field created by stationary coils inside the drum. Eddy currents generated in the rotating drum exert on the rotor a torque which varies with the amount of current admitted to the field coils.

A heavy duty model absorbs up to 5,000 horsepower, providing speeds from 800 r.p.m. down to a rate that permits the setting of slips on the heaviest strings of drill pipe.

The permanently sealed field coils are cooled by water circulating over the field casting and eddy current members. But DC 996 excludes moisture indefinitely even at high operating temperatures. Insulation resistance remains high despite long exposure to weather when a rig is idle. And, when drilling is resumed, this resistance rises rapidly and soon reaches infinity.

DC 996 is described in leaflet No. W 3-4.

NOTE: See our Exhibit at the Electrical Engineering Exposition, New York, January 27 to 31.

DOW CORNING CORPORATION
MIDLAND, MICHIGAN
Chicago: Builders' Building
Cleveland: Terminal Tower
Los Angeles: 634 S. Spring Street
New York: Empire State Building
In Canada: Fiberglas Canada, Ltd., Toronto

Dow Corning
FIRST IN SILICONES

Obituary

T. F. LAKE, master mechanic of the Nevada Northern at East Ely, Nev., died on October 23.

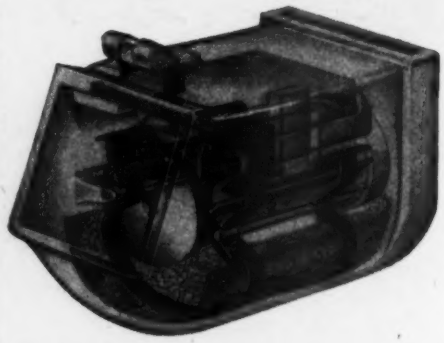
P. J. CALLAHAN, electrical foreman of the Boston & Maine at Boston, Mass., died on Saturday, November 30. During 1934-35 Mr. Callahan was president of the Association of Railway Electrical Engineers (now the Electrical Section, Mechanical Division, Association of American Railroads), in which association he had been a most active member for many years.

P. J. Callahan

HARRY L. WORMAN, chief operating officer of the St. Louis-San Francisco, died at St. Louis, Mo. on November 8. Mr. Worman was born at Salem, Ohio, on July 19, 1877. He began his railroad career in 1905 as a machinist in the employ of the St. Louis & San Francisco (now St. L.-S.-F.) at Kansas City, Mo. He later served as enginehouse foreman, erecting foreman and machine foreman at the Kansas City shops, and in 1911 became general foreman at Fort Scott, Kan. In 1916 he was promoted to the position of traveling enginehouse foreman. He was appointed master mechanic at Memphis, Tenn, in 1917; assistant superintendent motive power at Springfield, Mo., in 1919, superintendent motive power in 1920; vice-president in charge of operation in 1931, and chief operating officer in 1932.

Harry L. Worman

ROBOT PACKING
RETAINERS PREVENT
HOT BOXES



ROBOT Packing Retainers work ceaselessly to stop waste grabs by keeping packing in proper position and preventing any lint or strands of waste from the bearing. This is what it means to your road:

1
Saves *time and eliminates delay of trains setting out cars having hot boxes.*

2
Prevents *costly replacement of wheel and axle units due to cut journals.*

3
Increases *the service life of the journal bearings by insuring proper lubrication.*

4
Reduces *yard and terminal inspection time by keeping packing in proper position.*

5
Keeps *needed cars off the repair tracks and available for service.*

ROBOT Retainers are easy to apply and once installed will not require maintenance. They fit any style journal box including types with waste retaining ribs.

ROBOT Retainers are manufactured for locomotive tenders, passenger and freight cars in all journal sizes.

CHICAGO FREIGHT CAR & PARTS CO.
228 N. LA SALLE ST. · CHICAGO 1, ILLINOIS